INDUSTRIAL ENGINEERING

with which is consolidated

INDUSTRY ILLUSTRATED

Electrical, Mechanical and Plant Service in Industry

Volume 85 NEW YORK, DECEMBER, 1927 *Number 12*

A Bigger and Better Service to Our Old and New Friends

. . . . With this issue *Industry Illustrated* which has been acquired by the McGraw-Hill Publishing Company, Inc., from the Engineering Magazine Company is consolidated with *Industrial Engineering.*

. . . . The consolidation marks the beginning of a fully rounded and better editorial service to that vitally important group of men comprising the Service to Production.

. . . . In this group are the plant engineers and their collaborators, the chief electricians, master mechanics, materials handling engineers and superintendents of maintenance of buildings and equipment, and others, of whatever title, in all of the various industries in which the functions of power transmission, power application, materials handling, maintenance of plant equipment, and other numerous services are common problems.

. . . . These men, in performing the important work which comes under their supervision, find their responsibilities with respect to equipment divided into four heads — Selection, Installation, Operation and Maintenance. They exercise wide control of these four functions with respect to facilities and equipment tributary to production in all industries. They are responsible for the electrical and mechanical transmission apparatus, the motorization, the mechanical handling equipment, the facilities for lighting, heating and ventilating, and other classes of fixed and portable equipment which serve and aid production. They are charged with the responsibility also in many cases of keeping the actual production machines themselves in condition for maximum service through proper installation and maintenance.

. . . . For while production machinery, unlike equipment tributary to production, varies widely according to the industry concerned, the methods employed and the proper organization for good maintenance are common to all.

. . . . In addition, these men of the Service to Production usually find themselves responsible for the maintenance of buildings and structures. Altogether, they have a big job, and one that deserves all the help that a carefully planned, well-rounded industrial publication can render.

. . . . The consolidation of INDUSTRIAL ENGINEERING and INDUSTRY ILLUSTRATED is a big forward step toward giving these

men the adequate and effective editorial service that their importance demands.

. . . . INDUSTRIAL ENGINEERING brings to the combination a background of thoroughness and technical accuracy that is indispensable and a unique record of service to its readers, particularly in the field of electrified services. This treatment will be maintained and expanded, for electrical transmission, control and motorization permeate the entire structure of modern industry and an understanding of electrical technique and its developments is indispensable not only to the industrial electrician but also to those whose chief interests lie with the associated mechanical systems.

. . . . On the other hand, electrification in industry is one important means to an end, that being the establishment of the most economical, reliable and efficient means of doing the job of providing service to production. Mechanical means to this end are and must be inseparably interwoven with the electrical aspects in the daily thinking of the men who form this group. Electrical power transmission and mechanical power transmission go hand in hand in the factory. Mechanical handling or shop transportation is largely an electrified job. Motorization and control are important aspects of nearly every modern mechanical system.

. . . . The plant engineer and those with and under him are confronted daily with the problem of co-ordinating the electrical with the mechanical. To serve these men adequately this publication must maintain an adequate and rational editorial balance and coverage of electrical and mechanical subjects in their relation to the Service to Production.

. . . . INDUSTRY ILLUSTRATED brings to INDUSTRIAL ENGINEERING a wealth of experience in the editorial treatment of materials handling, mechanical transmission and the utilization and care of miscellaneous plant facilities and building and plant structure maintenance. It brings also rich possibilities for more effective presentation through the use of the pictorial idea, in those cases where pictures can convey ideas to the practical man more readily than words.

. . . . This treatment, however, will be in addition to and not at the expense of the more detailed editorial treatment which has proved so valuable to the readers of INDUSTRIAL ENGINEERING.

. . . . Beginning with the January issue, *Industrial Engineering with which is consolidated Industry Illustrated* will be published by the McGraw-Shaw Company which is a subsidiary of the McGraw-Hill Publishing Company, Inc., and the A. W. Shaw Company. This is not a merger of the parent publishing companies, but a subsidiary which brings together unusual facilities, experience and viewpoints. It permits of the development for this paper of an informational program of greater usefulness than either publication could have otherwise attained.

. . . . You will welcome, as we do, this opportunity to provide, in one bigger and better publication, a fully rounded and intensely practical editorial service for the men who keep Industry's wheels turning, its materials and products moving, and its plants and equipment in fighting trim.

McGRAW-HILL PUBLISHING COMPANY, INC.

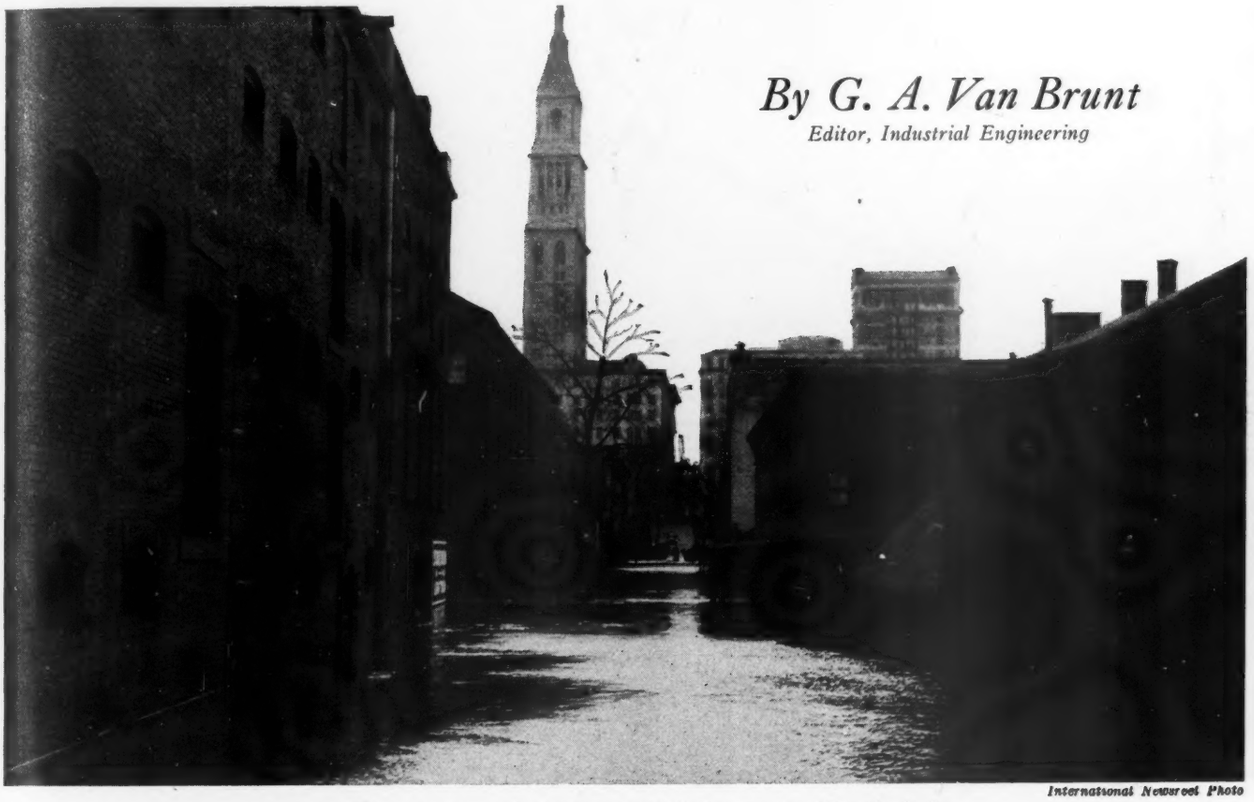
James H. McGraw

President

WHAT A FLOOD MEANS

to the Plant Engineer

By G. A. Van Brunt
Editor, Industrial Engineering



International Newsreel Photo

Fig. 1—When the Connecticut River invaded the streets of Hartford, Conn., flooding basements and ground floors of many establishments

WHEN a warm South wind met a cold North wind about the first of November, there ensued, over the New England states, a record-breaking rainstorm that lasted about 36 hours. Rivers reached stages seldom if ever exceeded and the resulting floods swept through towns and cities and countryside, causing damage estimated at nearly $30,000,000, and taking toll of between 80 and 90 lives. Houses, bridges, even two or three small villages were swept away as by a giant hand. Industrial plants in many cities were badly damaged and a few were completely destroyed. From all of them come interesting stories of rare devotion to duty, forgetfulness of self in the presence of danger and many examples of the rare ingenuity that plant men unfailingly display in emergencies, even when there is little time for action and less, or none at all, for thought. Precautionary measures that were taken to prevent damage to equipment, and methods employed to put water-soaked apparatus into operating condition, will be discussed in the following paragraphs.

As might be expected, industrial plants did not have much warning that a flood was coming. At Windsor Locks, Conn., for example, a number of plants are built on the banks of the Connecticut River. A considerable rise is expected every Spring and occasionally at other times, but as a rule no serious damage results.

When the river began to rise as a result of the heavy rain, it was confidently expected that the normal Spring flood stage would not be exceeded. Within two or three days the river was several feet higher than this. In consequence, basements and ground floors in some plants were under 2 or 3 ft. of water.

In one large paper mill all of the motors mounted on machines or near the floor in the basement were unbolted and lifted up a short distance by chain hoists, when the water reached the floor level. Within a few hours the water had risen so high that it was necessary for men, working in hip boots or on rafts, to raise the motors as high as the blocks would lift them. In a few instances holes had to be cut in the ceiling and motors pulled through to the floor above, to keep them out of the water.

It was thought at first that the starting compensators were mounted high enough to be out of danger. However, when it was found that this was not the case, it was impossible to move them and they were submerged.

The switchboard stood in about 3 ft. of water at the height of the flood, but beyond removing some watt-hour meters mounted on the lower panels, nothing could be done

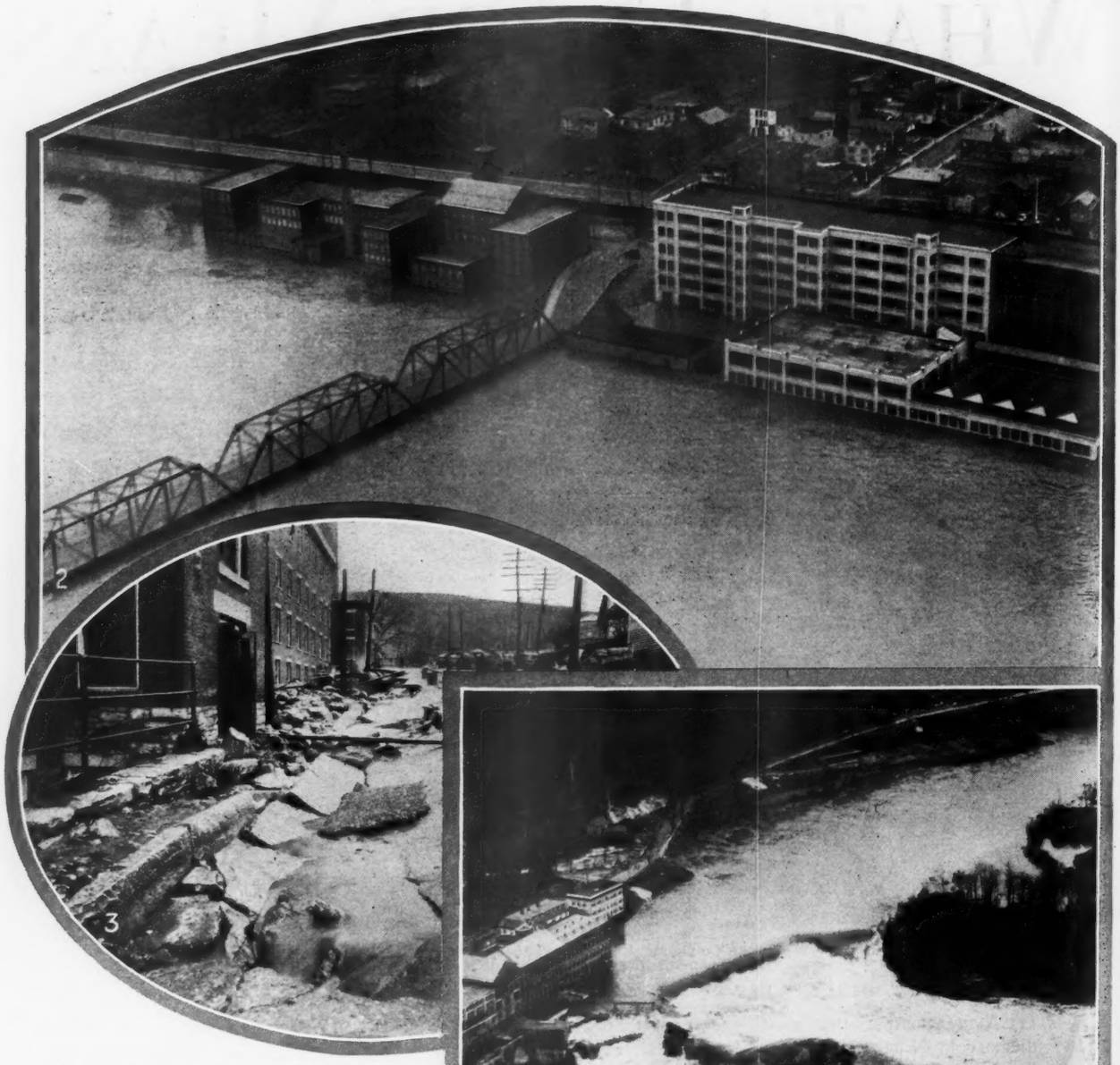


FIG. 2—AN AIRPLANE VIEW OF THE CONNECTICUT RIVER AT WINDSOR LOCKS, CONN.
P.A.A. Photo

FIG. 3—A STREET IN NORTH ADAMS, MASS., AFTER THE FLOOD SUBSIDED
In the cotton mill at the left the water was about 1½ ft. deep.

FIG. 4—WHEN THE FLOOD WAS AT ITS HEIGHT, AT WORONOCO, MASS.

to protect it. This mill generates most of its own power, and, with the boiler room flooded, no light or heat was available until the water went down.

When steam was gotten up, the compensators were taken apart and cleaned and the coils dried out for three days over steam coils. The same procedure was followed in the case of the oil switches on the board. In the meantime, the switchboard was taken down and all equipment thoroughly cleaned and dried.

Flood water always contains a large amount of very fine clay that penetrates into bearings and is difficult to remove. When machines of any kind have been submerged, it is necessary to take them apart and clean them carefully, especially the bearings.

In this paper mill the reconditioning process required one week of strenuous work. However, when operation was resumed no trouble was experienced with any of the electrical or other equipment.

In a large textile mill adjoining this plant only a small amount of electrical equipment was located in the basement and, with the exception of a large generator, it was moved to a safe place. The generator, which is mounted over a pit, was protected from the water by a thick wall of sandbags piled all around it.

Naturally, a considerable amount of water seeped through the sandbags and collected in the pit. However, it was pumped out from time to time by a pumper borrowed from the city fire department. Although the water was about 3 ft. deep in the room, the generator was kept dry.

The Springfield area, particularly West Springfield and Westfield, was badly hit by the flood. As in the case of some other districts, the failure of a dike greatly complicated a situation that was already bad.

In West Springfield, a large area of low-lying land contains a number of good-sized industrial plants, and is protected from the Agawam River by an earthen dike.

After the Agawam River had risen to an alarming height, word was received that the crest of the flood had been passed. In some plants at least, the danger was considered to be over, and no further precautions were taken. Then, early Saturday evening, the dike failed a short distance above the point where the Agawam flows into the Connecticut River, and a wall 10 or 15 ft. high of swirling, muddy water washed over several square miles of territory.

A paper box factory was one of the first plants to be engulfed. The water rose about 9 ft. in the office and factory. Two employees barely saved their lives by climbing up to the roof of the single-story plant and were taken off in rowboats. There was no time or means of protecting equipment or stock and damage was very heavy.

In an adjoining plant manufacturing gears and light metal parts, several machine operators did not have time to stop the motors before they

FIG. 5—THE CURIOUS FOUND A THRILL IN WATCHING THE CONNECTICUT RIVER RISE AT HARTFORD, CONN.

International Newsreel Photo

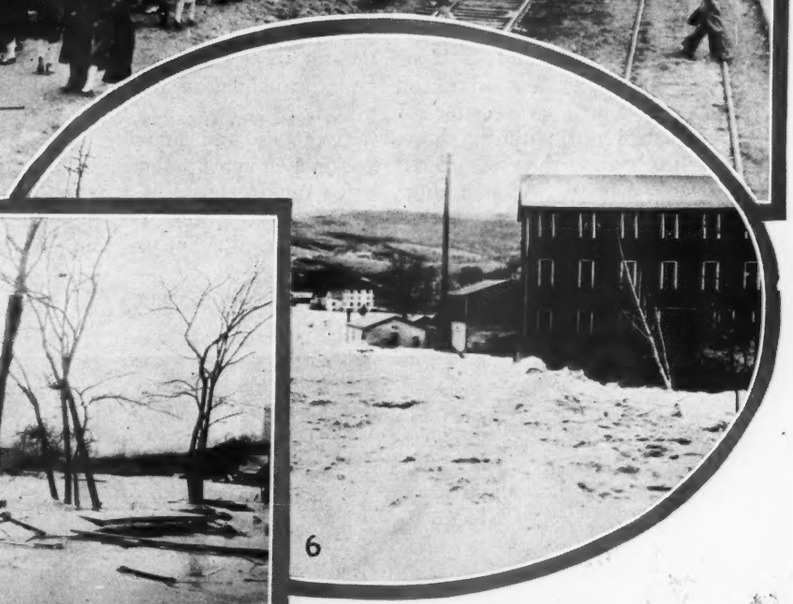


FIG. 6—FLOOD WATER TRANSFORMED THE PASSUMPSIC RIVER INTO A RAGING TORRENT AT ST. JOHNSBURY, VT.

Underwood & Underwood

FIG. 7—ANOTHER STREET IN NORTH ADAMS, MASS., BORDERING THE HOOSIC RIVER

FIG. 8 — THE SHIPPING PLATFORM OF A PLANT AT WEST SPRINGFIELD, MASS.

Later this switch engine furnished steam for a turbine-driven centrifugal pump that was used to remove the water from three tunnels that carry steam and power lines to the various plant buildings.

had to take refuge on the roof of the plant. When the water struck the bare conductors carrying power at 13,200 volts to the outdoor substation, the primary circuit breakers were tripped, thus cutting off the power and probably preventing serious damage to the motors.

The water rose to a height of 7 ft. 2 in. in this plant, so that all production tools and electrical equipment, including 22 motors and 20 starters, were totally submerged. At the end of three days the water was still about 2 ft. deep. However, as soon as it was possible to reach the plant by rowboats a gang of men was sent in and as a first step turned the fire hose on the machines, to wash off the heavy coating of mud. When the water finally receded it left a layer of clay-like mud 2 or 3 in. thick on the floor. As much as possible of this was flushed out with the hose, and sawdust was then scattered thickly over the floor. After a short time this was scraped off and another layer put on. This process was repeated until the floor was clean and then chloride of lime was sprinkled around as a disinfectant. It was realized that the flood water contained a large amount of sewage.

Sawdust was also shoveled over the machines to dry them off, before they were dissembled for a thorough cleaning. All bearings were taken down, cleaned, and fresh oil put in.

In the absence of a baking oven the motors and starting equipment were taken apart and dried out over improvised salamanders. When a 50,000-ohm magneto rang clear, the motors were put back on the line and after a week of operation had given no trouble. Although this method of drying out motors is hardly to be recommended except in a grave emergency, it appears to have been successful here, possibly because most of the motors were only a few months old and the insulation was in good condition.

Switches and starting equipment were taken apart and cleaned and coils dried out in the same manner as the motors. No trouble was experienced when the equipment was put back into service.

Conduit lines were, of course, flooded. As the quickest way of getting them into service, the wires were pulled out, wiped off, and dried. Swabs of waste were then pulled through the conduit, in order to remove the mud which filled them, after which the wires were again drawn in.

In this plant it was important to get production started as soon as possible. Consequently, while the electrical equipment was being reconditioned, a Fordson tractor was pressed into service to drive one of the main lineshafts. Production was resumed on some machines before water was entirely off the floor.

In one large metal working plant in this district three large tunnels radiate from the power house, carrying all steam, air, water and power lines to different sections of the plant. One of these tunnels is 16x8 ft. in section and 650 ft. long; another is 10x7 ft. in section and 800 ft. long; and the third is 10x7 ft., 450 ft. long. In all, these tunnels carry thirteen sets of three-phase, 550-volt, rubber-covered feeders in conduit.

In this plant the water rose to a

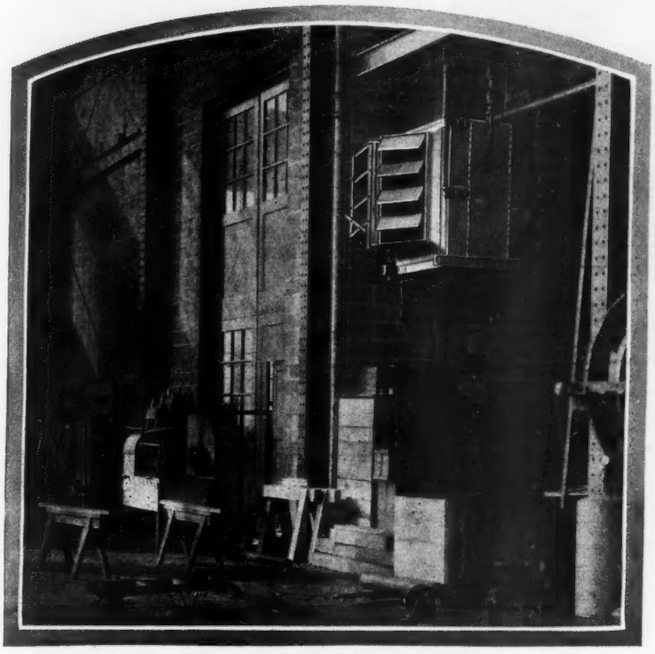
(Please turn to page 588)

FIG. 9—BRICK WALLS FELL BEFORE THE ONSLAUGHT OF ANGRY WATERS

This is one corner of a basket shop at Becket, Mass.

FIG. 10—POWER CABLES AND WATER, GAS, AND SEWER LINES WERE BROKEN WHEN PAVEMENTS WERE WASHED OUT

[If One Heater Is Inadequate Use Two]



Suspended-type heaters equipped with deflectors maintain an even temperature in cold corners

How to Determine the Requirements for HEATING The Cold Corner

by C. A. Booth
Vice-President, Buffalo Forge Co.
Buffalo, N. Y.

MODERN industrial plants of any size usually are heated with steam, or perhaps with hot water, both very satisfactory mediums, but the age-long struggle to get the best results with the least money often leaves sections which are poorly heated. Either errors are made in estimating the requirements, or unforeseen conditions arise, such as considerably increased glass surface or open shipping doors, so that cold corners result—places where men coming from warmer sections feel the cold severely. It is good business to keep these places comfortable if it can be done without too much trouble and expense, so in this article it is our purpose to show that wherever steam or hot water is available they can be used in an inexpensive way to get first-class results.

The cold corner may be simply a section that has been overlooked, for which no heat was thought necessary for ordinary comfort. In this case, it is a very simple problem. It may be that an unforeseen amount of heat is required on account of opening doors, or because the installation of an exhaust system for the removal of dust, or for ventilation in process work results in removing so much of the room heat that the temperature is lowered below the comfortable working point. In this case, the problem is a little more complicated.

Years ago heating apparatus, like most things in the factory, was installed by the "trial and error" method, which showed some curious results, but the better class of manufacturers and contractors today take into consideration in their heating problems not only the extremes of winter weather temperatures, but the material of which the building walls and roof are constructed, the amount of glass surface, whether it is a one-story building with a high roof or a building consisting of several floors of average height, or whether operating conditions will require a great deal of ventilation with resulting removal of warm air which must be replaced, all of these factors being reduced to a basis of heat units. After this is determined, the capacity of the heating system is specified to provide for the estimated heating requirements, and usually with a sufficient margin to provide for unforeseen conditions that frequently arise.

But how is the heat directed to where it is wanted? Warm air, being lighter than cold air, will naturally rise and diffuse, forming air currents which may equalize temperatures, but this often results in overheating the spaces where heat is not required, for example, under the roof, leaving the floors cold. This is especially noticeable in high buildings, consequently the fan system or mechanical distribution of air has been favored in manufacturing plants for many years, because it made it possible to send the hot air where it is wanted. Now we have the unit heater, a development of the central fan system. It consists of a small individual fan and heating coil, light in weight, requiring either a limited floor space or none at all. It is inexpensive to install, and not dependent on circulation of hot air by gravity, nor on large and unsightly air ducts throughout the plant, but able to supply hot air with about the same accuracy as the charge from a shotgun in the hands of an expert.

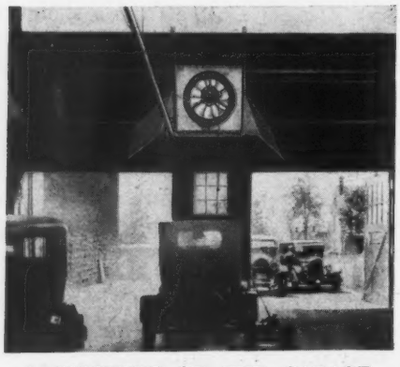
Direct radiation equipment is usually installed along the walls, but for heating large spaces by direct radiation, it is also necessary to either stretch coils overhead, or next to columns. The heated air rises, diffuses and falls again after being cooled, thus setting up currents which tend to raise the room temperature and equalize it but in actual practice are ineffective to the extent that the tendency to diffuse is easily offset by drafts or even by the ordinary chimney effect of cupolas and roof ventilators used in one-story factory buildings. Although types of unit heaters vary in regard to the dis-

tance their influence is felt, it is easily possible to heat uniformly a space which may be from 50 to 150 ft. distant. The air which is set in circulation is many times as great in volume as the actual delivery of the unit heater, as has been shown by the discharge of a smoke bomb in the path of the air discharge. This air acts on the principle of an ejector, creating motion all along the direction of its path, and spreading into distant corners where the eddy currents which are set up finally spend their force.

Most of the manufacturers of unit heaters maintain engineering departments for the purpose of making recommendations in specific cases. Nevertheless, it is desirable for the factory manager to know, at least approximately, what can be done, so we intend to mention the points to be considered, and their inherent influence on the selection of unit heaters for a few of the most frequently encountered cases.

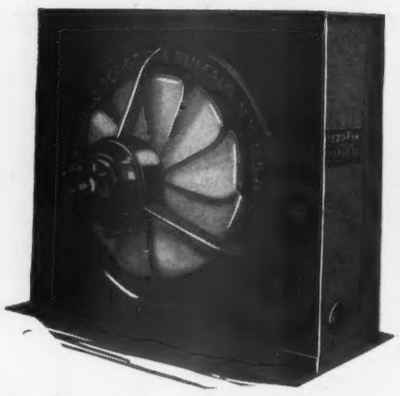
As an illustration, let us take a space which is part of a larger building and for which no heat has been provided. The space to be heated is exposed on two sides, only to outside walls.

Normally the determination of the actual heating requirements is based on the heat losses that will take place in the coldest weather, assuming minimum outside temperature and the desired temperature, say 60 deg., inside the building. These losses are ordinarily classified as infiltration or air leakage and losses by transmission or radiation through the various materials of which the building is constructed. Coefficients for heat transmission have been worked out by experiment over a great many years and are available in published form in text books on heating and ventilation, as well as in engineering handbooks. A few of these constants appear in the accompanying table as shown on page 557.



A SOLUTION OF THE GARAGE-HEATING PROBLEM

The Watson Stabilator Co. use a single, suspended unit equipped with large deflectors to direct the warm air toward the open doors.



LIGHT-WEIGHT, SUSPENDED-TYPE HEATER

A Buffalo Breezo-Fin unit heater with brass tube radiators. The extended surface, it is said, provides for a very high rate of condensation.

These constants represent the loss of heat in British thermal units for each degree difference between indoor and outdoor temperatures per square foot of surface. The total transmission loss is thus easily arrived at by selecting the proper constants for wall and roof, multiplying the net area of each after having deducted the area of glass surface, and then adding the heat losses through the windows and skylights by taking the area of each and the proper constant. It will be noted that a corrugated iron roof without sheathing loses heat at five times the rate for a tar and gravel roof laid over matched boards, yet sheathing under the corrugated iron reduces the heat loss nearly two-thirds. A brick wall has the same heat transmission as a tile wall of the same thickness, yet concrete loses heat more rapidly than either. As far as heat transmission is concerned, it will pay in cold climates to use sheathing and building paper, or some type of wallboard.

To these transmission losses for the roof and walls must be added the infiltration or leakage which is usually assumed for a factory building of ordinary construction to be from one-half to one and one-half air changes per hour. This means that a volume of outdoor air amounting to from 50 per cent to 150 per cent of the area to be heated will enter through open doors, cracks around windows, etc., and the same amount pass out through roof ventilators or skylights, or by drafts which will carry it into adjoining spaces of the buildings. This outdoor air must then be heated, so the heat thus required must be added to the transmission losses. In a well-built industrial plant of large size, an infiltration of one-half of the cubic content per hour is a fair assumption, but for a cold corner with cold spaces adjoining, however, it will be comparatively safer to figure on one and one-half air changes per hour.

This heat loss equation may be expressed as follows:

$$L = [C\ (T - t)\ 1.5] \div 55.2$$

In this C represents the cubic content to be heated, 1.5 the leakage factor, T and t indoor and outdoor temperatures respectively, and $1 \div 55.2$ which is the specific heat of air, or the number of B.t.u. required to heat one cubic foot of air one degree Fahrenheit.

On the assumption of a total heat requirement of 280,000 B.t.u. per hour for our cold corner, it will be necessary to install a heater of that capacity. Unit heaters are now rated on a guaranteed output in B.t.u., and may be purchased in sizes running from 100,000 to 1,000,000 B.t.u. capacity or over, and whether it may be better in this case to install one large unit or two small ones depends on the shape of the space. If it happens to be long and narrow, two units may be preferable, but if it is approximately square, a single unit would do just as well.

FLOOR-MOUNTED, BREEZI-FIN HEATER WITH RECIRCULATING BOX

The cool air enters at the floor level and is drawn through the steam coils, heating the cold corner in the plant of the Excelsior Mfg. Co.

In most cases it is unnecessary to draw air from outdoors, because sufficient leakage occurs to provide ample ventilation in most factory buildings, and recirculation of air is more economical for this purpose. Suppose two units are selected, each of about 150,000 B.t.u. capacity so as to provide a margin above the theoretical requirements, and which will make it possible to heat the space in mild weather with one unit. These heaters will probably be of the suspended type installed about 8 ft. above the floor so as to provide ample headroom and

placed in such position as to sweep the area to be heated. They will have deflectors so that the air will discharge in a slightly downward direction, and diffuse the air rapidly, so that it will not cause drafts, which are perceptible more than 15 or 20 ft. away, or by the time that the air has reached the working level. If it is a one-story building with a high roof, it may be necessary to use what are commonly known as recirculating boxes on these unit heaters so that the air will be drawn in at the floor line to establish a circuit by which the warm air will be given an increased tendency to confine circulation to the lower levels, instead of overheating the roof spaces. Recirculating boxes are never objectionable unless on account of the floor space they occupy. They are not necessary in industrial buildings having low ceilings.

Coefficients for Heat Transmission

Material for Walls		
Brick	8½ in. thick	0.37
Brick	13 in. thick	0.29
Tile	8 in. thick	0.40
Concrete	8 in. thick	0.60
Concrete	12 in. thick	0.47
Double board (paper between)	1½ in. thick	0.19
Board and corrugated iron	1 in thick	0.36
Corrugated iron siding		1.20
Clapboard, studs, lath and plaster		0.31
Material for Roofs		
Shingles on wood strips		0.87
Shingles on sheathing		0.43
Shingles, paper, and sheathing on strips		0.21
Tar paper on 1-in. roofing boards		0.44
Tar gravel and paper on matched boards		0.30
Slate on 1-in. boards		0.43
Tile and sheathing		0.64
Corrugated iron		1.50
Corrugated iron on sheathing		0.64
4-in. concrete with cinder fill		0.60
Single-glass windows		1.09

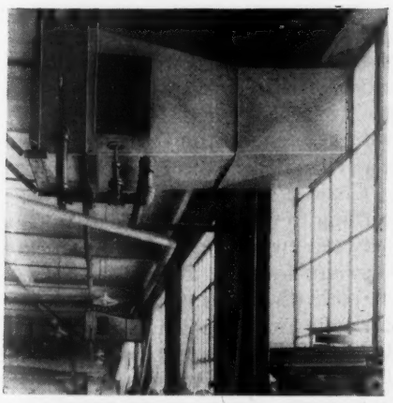
Unit heaters in general may be placed to advantage so that they will discharge warm air along the coldest wall, or where the wind exposure is most severely felt. If doors are opened frequently, this is a condition which must be specially provided for by an increased allowance for the cold air. It is quite obvious that direct radiation cannot handle this situation, but the unit heater placed so as to sweep a blanket of warm air across the door will minimize the drafts and sudden changes in temperature which result when large doors are opened in winter. Although no rule can be established to fit all cases, the amount of heat to be provided can be roughly estimated from the area of the door, the assumed velocity of air entering, which will, of course, depend on the exposure and prevailing winds, and the assumed temperature of this amount of air. The unit heater in this case must be large enough to offset this loss.

Some of the illustrations which accompany this article show actual installations of unit heaters. One of the many advantages is the convenience with which they may be located so as not to interfere with light, with the operation of machinery, with valuable floor space, or with the operation of cranes. There is a single steam supply and return line for each unit and a single valve to open for the proper regulation of the unit.

No precautions are necessary other than to estimate the average or extreme requirements, provide the necessary steam, and carry away the condensation. The small motor driven fans which are furnished as a part of the unit are quiet and efficient. The motors should be entirely inclosed, with waste-packed bearings, so as to require infrequent attention. The suspended units usually have brass tube radiators with an extended surface, giving a very high rate of condensation and a light-weight heater. Two unit heaters of this type, delivering 150,000 B.t.u. each, as in the case we assumed, would weigh about 260 lb. each, complete with fan and motor. The motors would be about ⅓ hp. The heaters would be self-contained, occupying a space approximately 4 ft. long, 30 in. high, and 24 in. deep.

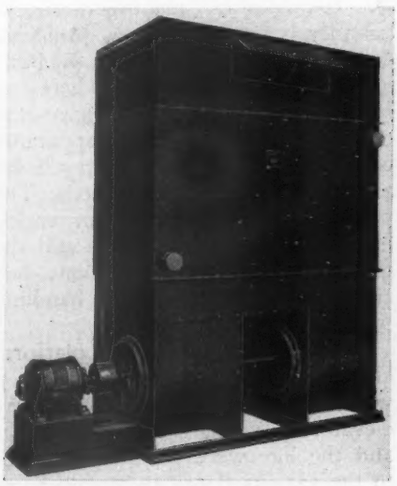
In selecting the units, it must be remembered that the heating capacity must be available with air entering the heater at room temperature; the same unit with air entering from outdoors would have a much greater B.t.u. capacity on account of the increased difference between the steam and air temperatures. A heater which will deliver 150,000 B.t.u. will have its output reduced nearly one-third when air enters from the outside at a temperature of 60 deg. F.

Obviously, the installation of a unit weighing less than 300 lb. is simple. It may be carried on a bracket or supported by hangers from the building structure. The smallest units are often hung from the steam pipe. If recirculating boxes are used they will carry the weight of the heater without requiring any other support. The installation expense is very small, and the results are all that may be desired from the operation. The portability of these units is another advantage, because they can be kept on hand for temporary use and moved from one position to another.



SUSPENDED-TYPE HEATERS IN THE PLANT OF THE IROQUOIS DOOR CO., BUFFALO, N. Y.

Valuable floor space is conserved for other work, when heaters are mounted overhead as shown. Recirculation is obtained without drafts on the workmen.



HIGH-PRESSURE STEAM IS NO BAR TO THE USE OF UNIT HEATERS

This Buffalo, floor-type heater is intended to serve the plant having a high-pressure system.

Two Elevator Shafts Plus an IDEA *Equal a* PLAN *in warehouse material handling that has exceeded all expectations*

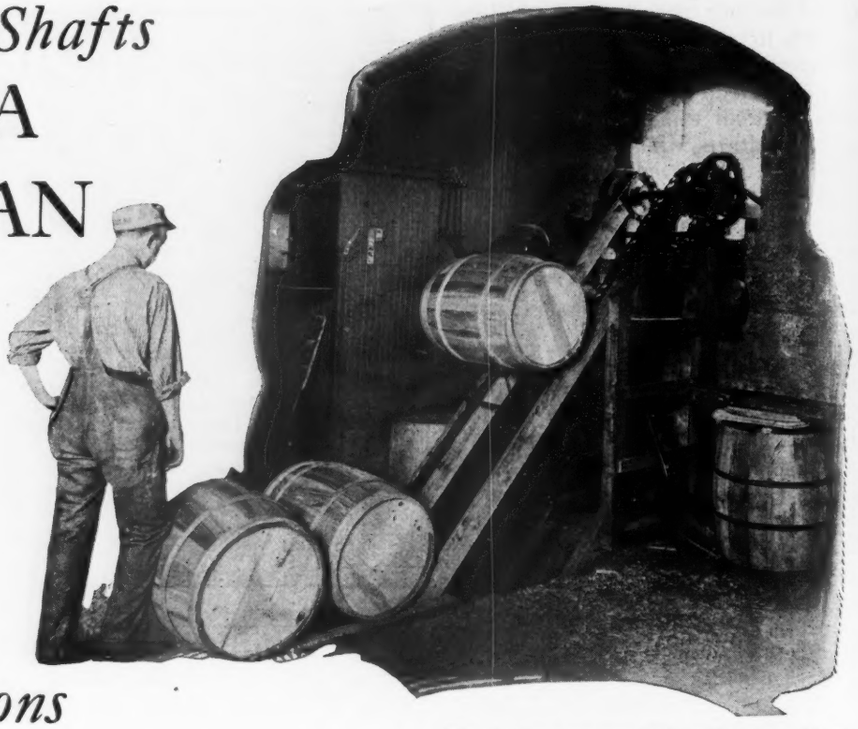


Fig. 1—Suppose you had to lift these 500-lb. barrels of castings from the storage to shipping platform?

EDWARD J. TOURNIER *tells how*

Chain Elevators *Recast Factory Methods*

PROPER correlation of various types of equipment for handling commodities manufactured in quantity is one of the new problems before executives. It is also the basis of the new style factory. There has been in the past a belief that some one class of handling apparatus could serve for a sort of carryall for any kind of manufactured goods. The particular kind of machinery varied in each plant, but there was still the thought that with adaptations one type would solve all of the handling problems.

In a recent instance a platform elevator serving five floors in a warehouse was displaced by a tray elevator. Packing boxes, bags, crates and the like were formerly brought to the various floors and taken away on hand trucks. The tray elevator works automatically, both in loading and unloading, and handles many times as much as the old platform elevator. And had it not been for a timely suggestion, the attempt would have been made to continue hauling goods away from the elevator by the use of hand trucks!

This and other instances will show not only how losses due to scrapped equipment are avoided, but also how combinations of different types of material handling machinery are molding industry in a new form.

The principal factor in the transfer of goods from one floor to another is the direction in which they are to be handled. It needs no explanation, for example, to see that lifting generally costs more than lowering. In the latter case gravity provides the power and in the former case gravity must be overcome by the use of power.

The functions of raising and lowering finished products have necessitated the development of devices for this specific work. These are grouped in two general classifications. The first includes spiral chutes and spiral gravity roller conveyors which are used for lowering only. The second includes chain elevators designed for both elevating and lowering. Elevators intended only for lifting are also classified in the second group.

Chain elevators are subdivided according to whether they are to operate between two floors only, or whether they are to serve a number of floors in both directions. In the first subdivision are the short elevators used to raise barrels, boxes, crates and the like from a basement storage to a workroom above, or to a freight platform.

The term "barrel elevator" is commonly used to describe the short elevators. These machines, as in Fig. 1, usually consist of two strands of chain

connected at intervals by cross rods to prevent spreading of the chains. Arms made of malleable iron or bent steel bars are attached to the chains on whatever longitudinal centers is required to obtain a given capacity for the unit.

The two strands of chain pass over sprockets at the top and bottom of the elevator, and are supported over the intermediate space between shafts by suitable members of timber or steel. The framework of the elevator is usually inclined and the chain guides are provided with flat-steel wearing bars on which the carrying strands of the chain travel. Power is supplied to the head shaft through a spur-gear transmission and a worm-gear speed reducer.

At the loading point, usually at the basement floor or at a point slightly above it, two skids are located in such a manner that the arms attached to the chain pass on the outside. A barrel or other container placed upon the skids will be lifted off by a pair of the moving arms, and on reaching the top of the elevator it will be discharged over the head sprockets as shown in Fig. 2.

Another set of skids at this point receives the package which slides down the incline to its destination. In the case of barrels the slope of the skids is very slight, although for boxes and bags the inclination must be steep. The principal use of such elevators, however, is in elevating barrels or other cylindrical containers. They are used for boxes and bags only where a very low first cost is the first consideration.

At the plant of the U. S. Cast Iron Pipe & Foundry, Burlington, N. J., a barrel elevator of the type described and shown in Fig. 1 is able to handle barrels of small castings weighing about 500 lb. each at the rate of 180 per hour, with only one man in attendance. The barrels are stored in the shipping room, which is slightly below the level of a railroad track adjacent to the building wall, and are delivered direct to the door of a box car. The unloading skids in this case are removable to allow cars to pass close to the wall.

The case just described shows the application of the simplest form of elevator. The service performed, however, cannot be evaluated, except approximately. The former practice had been to roll the barrels on skids into the car by hand labor, usually requiring two men, and in which frequent breakage of barrels was experienced. The elevator, however, reduced the labor to one man and eliminated the breakage.

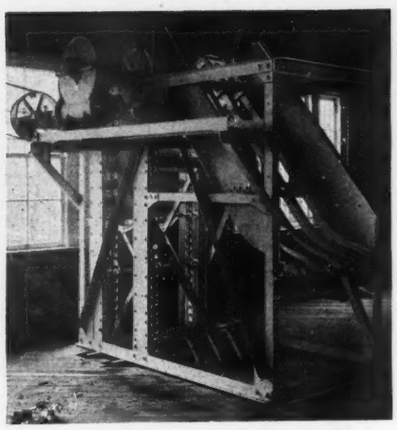


FIG. 2—SAFETY FEATURES ARE INCORPORATED IN THIS INSTALLATION

Note the worm-gear speed reducer application which prevents accidental reversal in the direction of operation. The elevator head is located on the top floor of the building.

For many years, a large warehouse in eastern New York, supplying the jobbing trade with practically every class of goods from groceries to gas heaters, handled all of its goods with two platform elevators and hand trucks. The building contains five floors and basement, covering an area about 150 ft. wide and 300 ft. long, or approximately 45,000 sq.ft. on each floor. The elevators were located, one at each end of the building, and each had a lifting capacity of 4,000 lb. Five men on each floor unloaded and distributed the boxes, bags, etc., as they were brought up from the lower floors.

A great expansion in the company's business, however, necessitated a reorganization of its handling methods. The platform elevators were inadequate and the distribution was too slow to take care of the movement of commodities to and from the storerooms.

It was then thought that an automatic tray elevator located in the shaft of one of the platform elevators would solve the problem. This, however, would involve scrapping the old elevator and would only partially improve conditions, because it was intended to retain the use of hand trucks. At this point, the warehouse superintendent made the suggestion that it was not necessary to scrap either of the old lifts. The new elevator could be placed centrally in the building, close to the wall, requiring only new openings in the floors. The goods brought up by the elevator could be discharged automatically on to a short apron conveyor, at any floor. They could then be placed on skids which could be taken up by electric lift trucks and distributed wherever needed. On some of the floors, the addition of a tiering machine would complete the system of unloading, distributing and stacking.

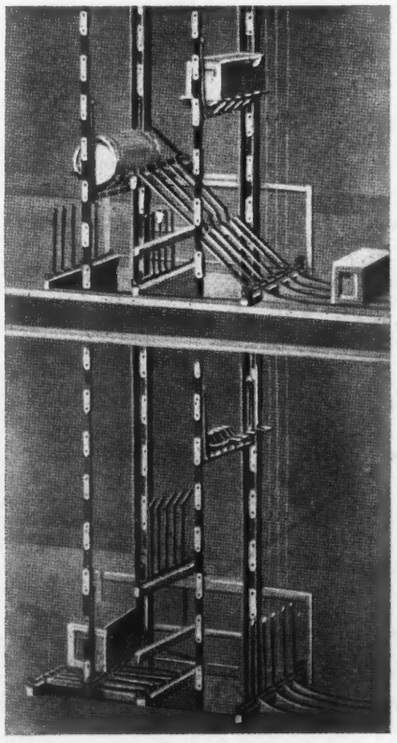


FIG. 3—NO TRAFFIC REGULATIONS HERE

Two way service is maintained with this automatic tray elevator, which also permits loading or unloading on either side.

Various objections were made to this plan, because it was necessary to lower as well as elevate the merchandise, because the expense would be too great, and because it would require recasting the receiving and shipping facilities, etc. However, the plans were finally adopted, substantially as outlined.

The tray elevator, Fig. 2, which is of the double-strand steel-chain type with cast-iron tray arms, extends from the basement to the fifth floor, a distance of about 70 ft. The trays are spaced 10 ft. apart, which, at a chain speed of 60 f.p.m., gives an hourly capacity of 360 packages weighing 400 lb. each. When fully loaded, the elevator is operated by a 10-hp. electric motor which drives through a worm-gear speed reducer and one spur-gear transmission.

At each floor there is a set of automatic unloading fingers, which are arranged either to load or unload, and which can be placed in position

manually if desired. A short steel apron conveyor with an independent motor drive is used to take the packages away from the elevator quickly. A number of platform skids are kept on hand at every floor near the discharge point of the elevator for this purpose.

These skids are large enough to hold boxes containing an average weight of 500 lb. each. The delivery point of the apron conveyor is arranged so that an elevating platform truck, as in Fig. 4, can receive a load of four of these boxes at one time. The use of two of the elevating trucks permits the almost continuous flow of goods away from the elevator. During the time that one truck is being loaded, the other is distributing its load to the various aisles on the floor.

The installation of this system of handling has required the use of a time schedule for the elevator, and also for the shipping platform, in order to accommodate storage and withdrawal of goods from the different floors. When goods are being shipped direct from the warehouse floors, the operation of the elevator for this particular service cannot be interrupted.

In like manner, storage operations must be continued to completion. As it sometimes happens that emergency shipments must be made when the elevator is in use for storage, a small "balancing" storeroom has been placed adjacent to the shipping platform.

After a year's service of the remodeled system, a number of expected results have been accomplished, and also one at least that was not thought of when the plan was made.

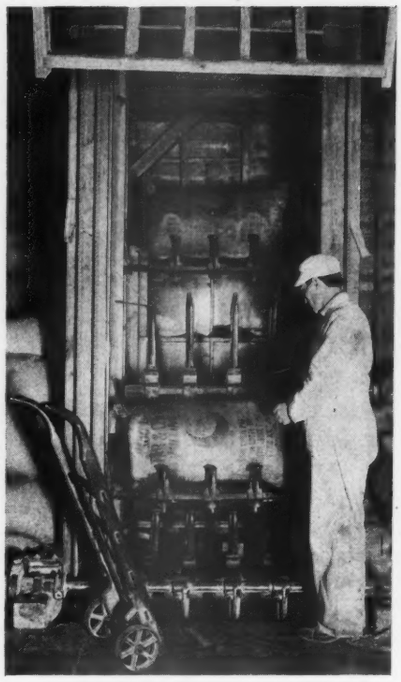


FIG. 5—WHY THE HAND TRUCK?
This is the way goods were handled from an intermediate point on the tray elevator before the platform trucks were adopted.

The installation of the tray elevator, Fig. 5, saved half the wages of one man at each loading and unloading point. The elevating platform trucks permitted the reduction of the labor force on each floor from four men to two, also the time of loading trucks has been reduced 50 per cent with one man less than previously employed.

If the financial side only is considered, it has been found that the savings in direct labor amount to about $8,500 annually; that the upkeep of concrete floors previously worn by truckwheels is eliminated, and that compensation insurance rates are much lower as a direct result.

It had been expected that one of the platform elevators would have to be scrapped, but as previously indicated both were kept. One of them is used for a purpose not thought of at first. During the time that the tray elevator is being used for lowering goods for shipment, only one platform truck, as in Fig. 6, is in service on each floor. The other may be used for other purposes. These spare trucks are placed on the old platform elevator and lowered to the shipping platform level, where they serve in loading motor trucks and for the miscellaneous shifting of goods. The circumstances in this case are unusual of course, as it was merely coincidence that the old elevators had especially large platforms.

All of the facts herein mentioned point to the conclusion that careful planning and co-ordination of suitable equipment produce results impossible by the indiscriminate purchase of even first-class equipment.

For every material handling problem there is a correct solution, and it is for the engineer with specialized knowledge to point out which type of equipment best suits the conditions in the particular industrial plant in which it is to be employed.

FIG. 4—PLATFORM TRUCK IS USED IN DISTRIBUTING GOODS ON THE VARIOUS FLOORS OF THE WAREHOUSE
Unexpected operating economies were obtained from the combination of this type of equipment and the tray elevator.

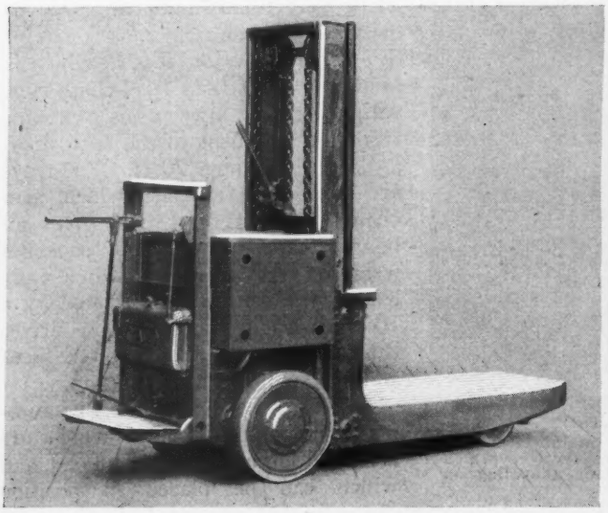


FIG. 6—COMPACTNESS AND UTILITY LEAD TO THE ADOPTION OF THIS TYPE OF PLATFORM TRUCK
Its short wheel base permits the driver to run it on a platform elevator so that it can be used in various parts of the building. All functions are governed from the driver's platform.

In this . . . . . the third article of a series on the selection of materials and the methods used in building and repairing commutators,

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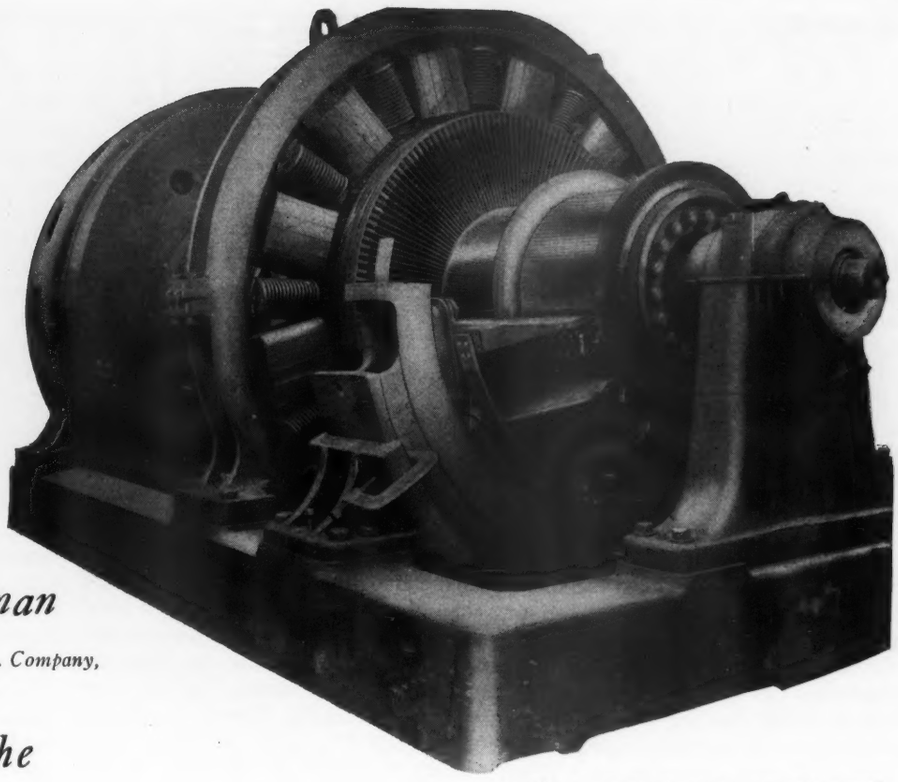


Fig. 1—A ring-bound commutator used for high-speed operation

describes the

Assembly of Commutator Segments

ACCURATE machining to the proper gage diameter is an essential in commutator construction. An explanation, therefore, of gage diameter, and a description of the tool used for measuring this diameter, will not be amiss at this time. The gage diameter of a commutator may be defined as the distance from the point of intersection of the 30 deg. and 3 deg. angles of the copper *V* to the corresponding point diametrically opposite. This is illustrated in Fig. 2 on page 562. Accurate measurement of this dimension can be obtained only with the use of a male bridge gage, as other tools such as scales and calipers do not give satisfactory results.

The accuracy of the gage diameter and the depth of the copper *V*'s are determined, as shown at *A* in Fig. 3, by means of the male bridge gage, which is a special tool made for this purpose. It is used to measure the diameter of the intersecting sides of the copper *V*'s and to check the accuracy of the angles of the *V*'s. This tool has two projections intersecting at two imaginary points which are the same distance apart as the gage diameter to which the copper *V*'s are machined. Since the *V*'s of the assembled segments for *V*-bound and drum-bound commutators are machined to a gage diameter, which is different than the gage diameter of the machined steel *V*'s by a definite predetermined figure, the male bridge gages used in measuring these segments are made different by the same predetermined amount.

The depth to which the *V*'s are to be machined is marked on the projecting *V*'s by a special tool as illustrated at *B* in Fig. 3. This tool is so made that it will fit over the end of the projecting *V* having a clamp which holds a steel scale. The extended 30 deg. and 3 deg. sides of the *V* of this tool have an intersecting point, which corresponds to the intersecting point of the sides of the copper *V*. For example, assume that the *V* is to be machined 2 in. deep. Then the 2-in. point of the steel scale is matched with the intersecting point of the *V* on the tool. The tool fits over each projecting *V* of the male bridge gage. The depth to which the *V* is to be machined is designated by the end of the steel scale. These points being marked on the side of each projecting *V* of the male bridge gage will be in alignment with the end of the bar as shown at *A* and *B* in Fig. 4, when the correct machined depth of the *V*'s has been obtained.

Since there are three different types of commutator construction used on d.c. industrial motors, there are three different methods of preparing the assembled copper bars and mica strips for use in these commutators. The three types of commutator construction are:

(*1*) Arch-bound.
(*2*) V-bound.
(*3*) Drum-bound.
  (*a*) Standard construction.
  (*b*) Shrink-ring construction.

In an arch-bound commutator, the copper bars and mica strips form an arch. The steel *V*'s of the bush-

ing, as indicated at *A* in Fig. 5, exert a radial force directly on the 30 deg. angle of the *V*'s of the copper bars and mica strips until they arch bind. This places the mica strips under a constant pressure when the commutator is tight.

Earlier commutators were of this type and it was necessary to tighten the commutator and re-turn the surface at the slightest indication of high bars. High bars were due to the whole structure loosening during the so-called process of seasoning, when the bond in the mica strips squeezed out, or if any shrinkage of the mica should be prevalent. This led to the development of the *V*-bound commutator.

After extensive tests, it was found that by machining the gage diameter of the *V*'s of assembled segments to a definite predetermined amount, which is dependent upon the size of the commutator, different than the gage diameter of the steel *V*-ring, it was possible to eliminate the difficulty encountered with high bars on the arch-bound commutators. When the commutator is assembled, the pressure of the mica *V*-ring is first exerted on the 3 deg. angle of the copper *V*. When the banding wire is cut, the bars will all push outward, thus sufficiently relieving the arch-bound pressure between the copper bars and mica strips so that each bar will be held firm by the *V*-ring. When assembling cold, opened-up places will appear after the banding wire is cut. This is how the name "opened-up" commutator was applied.

After the assembled commutator has been heated and a pressure applied to the steel *V*-ring, the pressure is also applied to the 30 deg. angle of the copper *V*, thus drawing the bars in. When the assembly is cold, pressure will be applied on the 30 deg. as well as the 3 deg. angle, as indicated at *B* in Fig. 5, thus holding each individual bar firmly so that it cannot rise or lower, should the bond squeeze out or the mica strips shrink. This can be proved by disassembling a commutator, and noting that both the 3 deg. and 30 deg. angles of the bar are seated firmly in the mica ring.

The drum-bound standard construction is used mostly on large commutators of the large reversing motors and power generating apparatus found in the average industrial plant. Commutators of this type are assembled by having the bars forced in radially until they bind on the bushing. In order to obtain this condition, it is necessary to machine the bore and the gage diameter of the *V*'s a definite predetermined amount, which is dependent on the gage diameter of the commutator, different than the gage diameter of the steel *V*'s. When the segments are assembled on the bushing, the pressure on the mica between the bars, as shown at *C* in Fig. 5, will be relieved sufficiently to permit the bars to be drawn in by a radial pressure so that the bars will bind on the bushing.

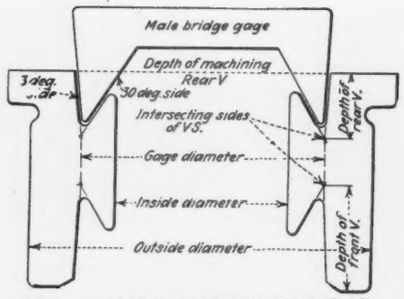


FIG. 2—MALE BRIDGE FOR GAGING COMMUTATORS

This tool has two projections intersecting at two imaginary points which are the same distance apart as the gage diameter to which the copper *V*'s are machined.

With the drum-bound shrink-ring construction it is necessary to provide an additional means of sustaining the bars on commutators having a long brush face which must be operated at high speeds. This is accomplished by shrinking a metal ring over the copper segments, as may be noted in Fig. 1. The commutator is assembled and seasoned in the same manner as the drum-bound commutator. After the commutator has been properly seasoned, one or more metal rings are shrunk over the commutator face. The number of rings is dependent on the length of the commutator face and the peripheral speed of the commutator.

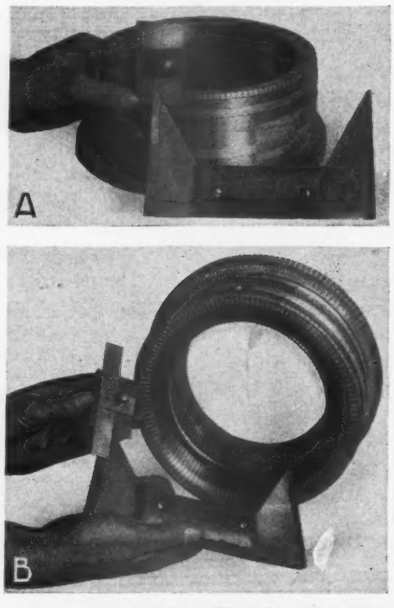


FIG. 3—CHECKING THE ACCURACY OF THE GAGE DIAMETER

The special tool in *A* is used to mark the depth of the *V*'s so that they may be measured as in Fig. 4. This tool, which holds a steel scale as in *B*, is so made that it will fit over the end of the projecting *V*.

If no mica extension is desired, the building is done on a flat surface, as shown in Fig. 6. After the mica strips and copper bars are built on a building plate, they are assembled on a dummy bushing. The assembled segments are then placed in an oven and heated to 150 deg. C. A split ring, having a tapered face on the outside, is placed around the assembled segments while they are hot. A strip of fishpaper is placed between the ring and the assembled segments. A solid ring, which has a reversed tapered face on the inside, as in Fig. 7, is placed over the split ring and pressed on at a pressure of from 20 to 30 tons. This produces an arch-bound assembly. The dummy bushing is then removed and the commutator is allowed to cool before the *V*'s are machined.

As soon as the rectangular copper bars and mica strips are built up, a three-piece clamp ring, as shown in Fig. 7, is placed around them and the bolts are drawn tight, a strip of fishpaper being placed between the ring and the assembled segments. It is important that the assembled segments form as true a circle as possible. After the clamping ring is tightened around the assembled segments, they are placed in an oven and heated at 150 deg. C. The bolts on the clamping ring are then pulled tight, forming an arch-bound assembly.

On large diameter commutators, it is necessary to use a solid ring with set screws and segmental blocks for clamping the segments. The segmental blocks, as illustrated in Fig. 8, span two set screws and are cut beveled so that they overlap, thus applying a pressure to every bar.

In the manufacture of a set of assembled segments there are certain refinements which are essential, if the life and service are expected to equal those of the original commutator. The lack of these refinements often causes unnecessary commutator failures. Every commutator failure invariably means damaged armature coils and various other troubles which will cause delays in service so that one must take into consideration the cost of the delays caused by a commutator failure when

FIG. 4—A SPECIAL MALE BRIDGE GAGE USED IN CHECKING ASSEMBLED SEGMENTS

The machined *V* in the set of assembled segments is checked during the machining operation as in *A* at left. Final checks are made as in *B* at right, when the correct machined depth of the *V*'s has been obtained.

specifying renewal commutators. Some of the refinements necessary in the manufacture of assembled commutator segments are as follows:

(1) The copper bars and mica strips should meet the requirements outlined in parts *I* and *II* of this series of articles.

(2a) A rear mica extension of $\frac{1}{16}$ in. should be allowed on all 500-volt commutators when possible. It serves as a barrier between the bars, thus eliminating the possibility of short circuits caused by solder while soldering the armature leads. It also increases the creepage distance between bars at this point.

(2b) A mica extension of $\frac{1}{32}$ in. is desirable in the bore of the assembled commutator segment. This mica extension, along with a $\frac{1}{32}$-in. radius at the bottom chord of the bar, provides ample creepage distance between bars. Sometimes the distance between the commutator spider and the bore of the assembled segments is so small that it is necessary to machine the bore in order to provide sufficient clearance to assemble the mica *V*-ring and mica bushing. When the bore is machined, the burr, which is dragged to one side of the bar by the machine tool, should be removed by a special engraving tool being drawn over the mica strip. This tool gives the bar a small radius as well as removing all copper "drag overs," thus increasing the creepage distance between bars.

(3a) The commutator bars should not be out of axial alignment more than the width of a mica strip. It is essential that the bars be parallel with the carbon so that the brush will short-circuit the same bars at the front of the commutator as at the rear.

(3b) The distance from any bar to the corresponding bar under the next pole should not vary more than plus or minus $\frac{1}{32}$ in. This variation is controlled by keeping the variation of the copper bars and mica strips within the specified variation of plus or minus 0.001 in. If this variation is larger or smaller, sparking may be prevalent at these spots. This is equivalent to increasing or decreasing the width of the commutating zone while the brush setting remains constant. Consequently, when a wider or narrower commutating zone passes under the brushes, they must short-circuit bars connected to coils whose potential is not zero. Therefore, sparking may be prevalent at these points.

(4a) Assembled segments should be heated to a temperature of from 125 deg. to 150 deg. C., in an automatic temperature controlled oven before the *V*'s are machined.

(4b) The process of heating the assembled commutator segments before the *V*'s are machined is neither to drive out the moisture, nor to get rid of the excess bond, as the mica plate should not contain live bond which will squeeze out. They are heated above the maximum temperature to which they will be subjected in service, so that the bond in the mica, which is hard when it is cold, will soften and conform or adjust itself to the irregularities of the bars. This permits the clamping ring to draw the individual bars into a tight arch-bound assembly under maximum temperature conditions to which it will be subjected in service. It is this adjusting quality of mica which makes

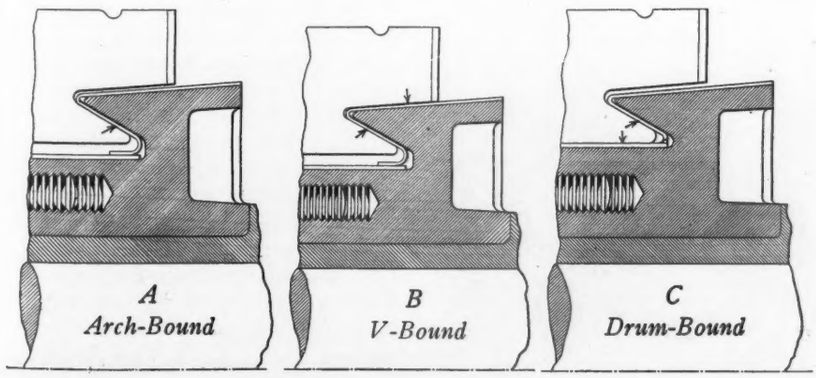


FIG. 5—PRESSURE DISTRIBUTION IN THE THREE TYPES OF COMMUTATORS

In *A*, the steel *V*'s of the spider and metal *V*-ring exert a radial force directly on the 30 deg. angle of the assembled segment. In *B*, the pressure is applied to both the 3 deg. and 30 deg. angles, thus holding each individual bar firm. In *C*, the pressure of the metal *V*'s of the spider and *V*-ring exerts a radial force on the 30 deg. angle of the copper *V* until the bore of the assembled segments binds on the body of the bushing. The mica strips are under sufficient pressure to keep out oil and moisture. The points of pressure are indicated by the arrows.

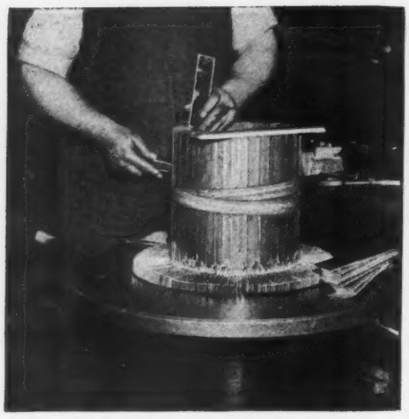


FIG. 6—BUILDING OPERATION ON A FLAT PLATE

When no mica extension is used the mica strips and copper bars are assembled on a dummy bushing.

the breathing action of a commutator possible when it passes through the alternate heating and cooling periods in operation. The use of the mica plate, which does not have the bond seasoned, should be avoided for use as commutator strips, as the bond will squeeze out.

(4c) Heating softens the surface shellac, thus cementing the copper bars and mica strips into a solid body and facilitating assembling when the banding wire is cut. This cementing action of the surface shellac on the mica strips also keeps the oil and moisture absorption at a minimum.

(5a) The *V*'s of the assembled segments must be machined with a machine tool held in a positive slide set for each angle. This insures that the 30 deg. and 3 deg. angles will always be symmetrical with the gage line, insuring absolute interchangeability and a tight fitting job when the commutator is assembled. If the angles are not symmetrical, the designated 30 deg. angle may be 29 deg., thus making the designated 3 deg. angle 4 deg. It can be seen that, with this condition, a space will be left between the 3 deg. angle of the copper and the mica *V*-ring. When this happens, it is necessary to remove the *V*-ring and build it up so as to make the commutator tight at this point, thus keeping the oil out.

(5b) The gage diameter of the assembled segments must be machined so as to relieve the arch-bound pressure between the bars sufficiently to produce the *V*-bound and drum-bound types of construction. This has been discussed in the preceding part of the article.

(5c) The machined *V*'s must be gaged with a permanent male bridge gage while they are held by the steel clamping ring. The use of this gage has been discussed in a preceding paragraph.

(5d) The 3 deg. angle of the assembled segments must be machined so that it will form a tight joint between the copper bars and the mica *V*-ring, thus keeping the oil and moisture from penetrating the commutator.

(6) All burrs and copper drag overs from the machining operation in the *V*'s must be removed by running an engraving tool over the mica strip between the bars in the *V*'s.

(7) The machined *V*'s should be painted with a coat of thin shellac. This protects the *V*'s from dirt, oil and moisture while in storage.

(8) The milled slots for the conductors in the solid-neck commutators should have the bottom corner at the rear of the slot rounded. If a sharp edge is allowed to remain at this point, it may cause a nick in the armature coil lead, thereby increasing the possibility of broken leads.

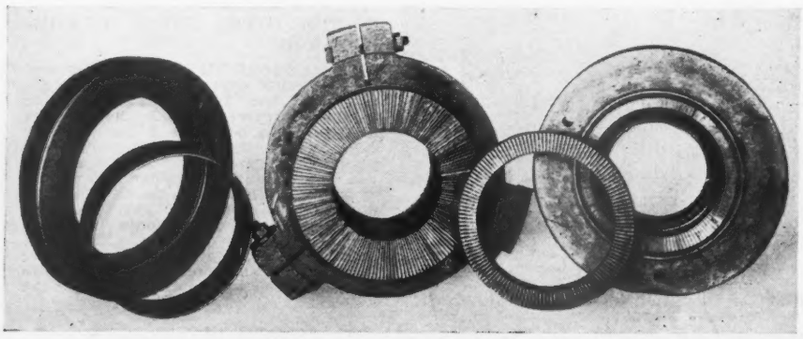
(9) The milled slots should be coated with pure resin flux to eliminate corrosion and to facilitate the soldering of the leads when winding the armature.

(10) Where the assembled segments are to be used with a two-piece mica *V*-ring, a duct must be machined in the bottom of the *V*'s for the clearance of the mica *V*-ring.

(11) A 500-volt bar to bar test should be made to show up any possible short circuits.

FIG. 7—TWO METHODS OF CLAMPING ASSEMBLED SEGMENTS

As soon as the rectangular copper bars and mica strips are built up, a solid ring is pressed on, or a three-piece clamp ring is placed around them and the bolts drawn tight.



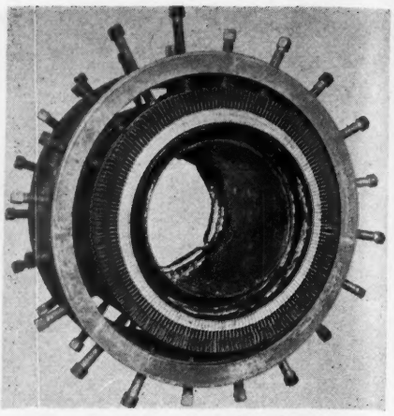


FIG. 8—SOLID CLAMP RING USED ON LARGE DIAMETER COMMUTATORS

The segmental blocks span two set screws and are cut beveled so that they overlap, thus applying a pressure to every bar.

Polarity Tests for Series, Shunt and Interpole Field Connections

VARIOUS tests are in use for determining the polarity of series, shunt and interpole fields in a direct current machine in order to check if they are properly connected in the circuit. In putting a compound-wound machine in service, it is frequently necessary to check the action of the series and shunt fields separately, that is, determine whether they assist or buck one another. In the case of a motor, or even a generator where a suitable power supply is available, a commonly used test is to disconnect the shunt field and connect the machine to the line for just long enough to determine the direction of rotation. If the series and shunt fields assist one another, then the direction of rotation should be the same whether the shunt field is disconnected or not. In the case of a compound-wound motor, which is virtually a series motor with only a very light shunt winding for stability, this test should be made with each field winding separately in circuit.

In an interpole machine, the armature and interpole windings must always be considered as one winding when making any changes.

Madison, N. J. C. D. VAN ANDEN.

Efficiency, smooth operation, and low maintenance cost can be achieved only by regular and thorough inspection and lubrication of equipment

J. F. MORGAN *tells how*

Scheduled Oiling

Prevents Motor Trouble

SEVERAL years ago, after experiencing considerable trouble and delays because of motor bearing failures, we concluded that our motors were not being oiled and cleaned regularly and often enough. The oiling and cleaning of all motors was done by a man outside of the control of the electric department, which had no jurisdiction as to the amount of time this oiler should spend on the motors. However, he was "supposed" to give all necessary attention to the motor bearings.

In order to prove our contention that insufficient attention was being given to the motors, we had a number of cards printed which carried the numbers of all the motors. The oiler was asked to check off the numbers of the motors as he oiled and cleaned them. This plan was tried for about a month. The cards showed that one motor, in the cafeteria kitchen, was visited daily, while a number of others had not been touched.

We then put into effect a schedule of oiling which provided for a regular examination once every two weeks of each motor under the oiler's care. Since this plan has been inaugurated, our motors have been giving better service. We feel that the system is satisfactory for our class of work, which is the manufacturing of hosiery and underwear from wool, cotton, silk and rayon.

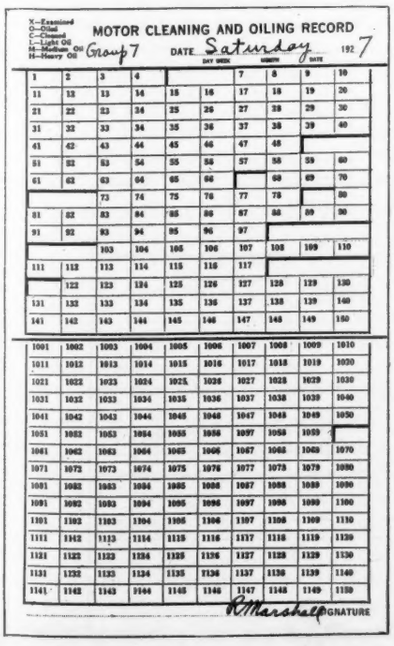
Of the 231 motors of various sizes in the plant the oiler takes care of 159, which includes all the larger motors and some of the smaller ones. The remaining 72 motors are oiled by members of the several departments in which the motors are located. One department with 57 small motors uses the "Oiling" cards, checking off the numbers of each motor as serviced, and afterwards the cards are sent to the electrical department. This oiling is done on or about the first and fifteenth of each month.

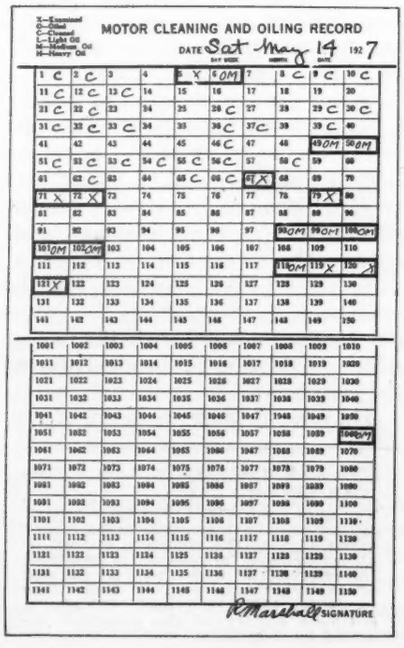
When forming the schedule of oiling for the oiler, the 159 motors were listed under 12 groups and each group given a schedule number for reference purposes. The numbers chosen for these groups were 2 to 7 and 9 to 14, inclusive; these numbers corresponded to the 12 working days in a period of two weeks.

The arrangement or grouping of the various departments and the method of assignment or scheduling to the various days of the two-week period is indicated in Table I. In two cases two of the smaller departments are handled in a day.

A list of oiling dates for the year was prepared, Table II, using the first Monday in the year (Jan. 3, in 1927) as the starting point. This became the first date of Group or Index 2; the next day became the first date of Group 3, and so on. Each group of motors has servicing dates recurring each two weeks, as indicated on the index schedule, Table II. This gives each group of motors 25 or 26 oiling dates during the year.

To simplify the marking of the daily cards, which are given to the oiler, 12 stencils were cut out of "daily cards." Each stencil was made by cutting out the numbers of





FIGS. 1 AND 2—THE STENCIL AT LEFT IS USED TO MARK CARD AT RIGHT

This stencil is for group 7, and is used on the dates indicated under No. 7 in Table II. Rectangles are drawn with red crayon by using the stencil on the oiler's card. The servicing given each motor is indicated by symbols placed alongside the motor number.

Table I—Grouped Departments for Oiling

Departments	Index No.	Day of Week
Worsted	2	Monday
Picker building	3	Tuesday
Mechanical	4	Wednesday
Stores and basement	4	Wednesday
General and office	5	Thursday
Underwear drying	6	Friday
Dyehouse	7	Saturday
Hosiery knitting	9	Monday
Underwear knitting	9	Monday
Winding, sewing, boxing	10	Tuesday
Underwear sewing, boxing	11	Wednesday
Hosiery boarding, boxing	12	Thursday
Spinning and carding	13	Friday
Carding	14	Saturday

TABLE II—OILING DATES, 1927 INDEX

GROUP	No.2	No.3	No.4	No.5	No.6	No.7	No.9	No.10	No.11	No.12	No.13	No.14
Jan.	3,17,31	4,18	5,19	6,20	7,21	8,22	10,24	11,25	12,26	13,27	14,28	1,1529
Feb.	14,28	1,15	2,16	3,17	4,18	5,19	7,21	8,22	9,23	10,24	11,25	12,26
Mar.	14,28	1,15	2,16	3,17	4,18	5,19	7,21	8,22	9,23	10,24	11,25	12,26
Apr.	11,25	12,26	13,27	14,28	1,15,29	2,16,30	4,18	5,19	6,20	7,21	8,22	9,23
May	9,23	10,24	11,25	12,26	13,27	14,28	2,16,30	3,17,31	4,18	5,19	6,20	7,21
June	6,20	7,21	8,22	9,23	10,24	11,25	13,27	14,28	1,15,29	2,16,30	3,17	4,18
July	4,18	5,19	6,20	7,21	8,22	9,23	11,25	12,26	13,27	14,26	1,15,29	2,16,30
Aug.	1,15,29	2,16,30	3,17,31	4,18	5,19	6,20	8,22	9,23	10,24	11,25	12,26	13,27
Sept.	12,26	13,27	14,28	1,15,29	2,16,30	3,17	5,19	6,20	7,21	8,22	9,23	10,24
Oct.	10,24	11,25	12,26	13,27	14,28	1,15,29	3,17,31	4,18	5,19	6,20	7,21	8,22
Nov.	7,21	8,22	9,23	10,24	11,25	12,26	14,28	1,15,29	2,16,30	3,17	4,18	5,19
Dec.	5,19	6,20	7,21	8,22	9,23	10,24	12,26	13,27	14,28	1,15,29	2,16,30	3,17,31

all the motors in each group. The stencil for Group 7, Fig. 1, indicates the motors to be oiled in the dyehouse every other Saturday.

A month's supply of daily cards is usually prepared at a time. This is done by first marking the date on each card, and then using the different stencils in rotation. Rectangular enclosures are marked with a colored pencil around the numbers of the motors to be oiled.

Fig. 2 shows a card which has been marked up from the stencil, Fig. 1, for Saturday, May 14, 1927, and the notations which have been made on the card by the oiler. When motors are added to or removed from the different departments, the stencils are changed or new ones cut. With the aid of the stencils 25 to 30 cards can be marked, ready for the oiler, in a few minutes.

The oiler marks, on the daily card, Fig. 2, the symbols showing what he did to each motor visited, and the cards are returned to the electrical department, where the information is transferred to yearly cards. Fig. 3 is the yearly card for motor No. 50. These cards show when the oil was last changed, or the motor cleaned, and indicate if a motor is requiring more than the usual attention.

Oiling oftener than usual usually indicates worn bearings or other defects requiring specific attention. Sometimes, of course, a motor may require attention in between regular oiling dates, as when a belt is tightened. The large number of "C's" (cleaned) on Fig. 3 indicates that the operator took advantage of the Saturday to clean a number of the motors which could not be handled during the week.

The oiler finds the cards are of considerable assistance to him, because each day's allotment of motors is plainly indicated. He knows, too, that he will not miss any motors on account of poor memory, as sometimes happens if memory alone is depended upon to remember motors in out-of-the-way places.

We have tried this method for over two years, and while it may appear to necessitate considerable work, we have found after the cards are once put in use, very little work is required to keep the records up to date. With an occasional checking of different motors by another man, we feel confident that the motors are receiving regular attention.

MOTOR OILING RECORD FOR 1925

Motor No. 50 Department Underwear Wash House Index No. 3,&7

	OILING DATES	OILED	EXAMINED	CLEANED	OIL CHANGED	
Jan.	6,20	6,20	17	17		
Feb.	3,17	17	3		17	
Mar.	3,17,31	3	17,31			
Apr.	14		14			← Oiling changed from Tuesday to Saturday
May	2,16,30	2,16	30	30		
June	13,27	13,27				
July	11,25		11,25			
Aug.	8,22	8	22	8	8	
Sep.	5,19		5,19	5,19		
Oct.	3,17,31	3	17,31			
Nov.	14,28		14,28			
Dec.	12,26	12,26			26	

MOTOR OILING RECORD FOR 1926

Motor No. 50 Department Underwear Wash House Index No. 7

	OILING DATES	OILED	EXAMINED	CLEANED	OIL CHANGED	
Jan.	9,23		9,23			
Feb.	6,20		6,20	20		
Mar.	6,20	6	20			
Apr.	3,17	3,17		3		
May	1,15,29	1	15,29	15		
June	12,26		12,26			
July	10,24		10,24			
Aug.	7,21	7,21			7	
Sep.	4,18	18	4	18		
Oct.	2,16,30	2	16,30			
Nov.	13,27		13,27	13		
Dec.	11,25		11,24			

MOTOR OILING RECORD FOR 1927

Motor No. 50 Department Underwear Wash House Index No. 7

	OILING DATES	OILED	EXAMINED	CLEANED	OIL CHANGED	
Jan.	8,22	22	8		22	
Feb.	5,19	5,19				
Mar.	5,19	5,19		5		
Apr.	2,16,30	16.	2, 30.			
May	14,28	14,				
June	11,25					
July	9,23					
Aug.	6,20					
Sep.	3,17					
Oct.	1,15,29					
Nov.	12,26					
Dec.	10,24					

FIG. 3—EACH MOTOR HAS A SIMILAR RECORD CARD

The data from Fig. 2, the daily report, are entered on these individual record cards so that the complete history of all servicing of any motor is available for reference at any time. At the end of the year this card is filed. The cards for 1925, 1926, and 1927 give a complete history of the attention received by this motor.

Operating Furnace Doors Electrically

How it was done is told by

E. G. Peterson

Electrical Engineer, The Cutler-Hammer Mfg. Company, Milwaukee, Wis.

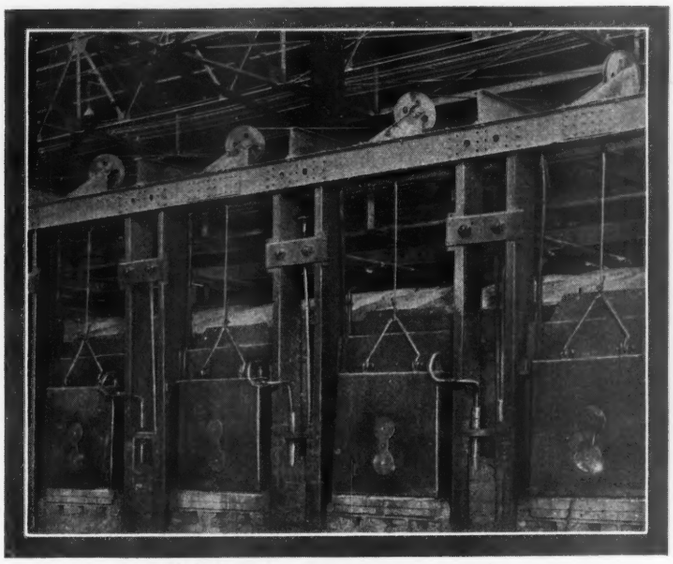


Fig. 1—A front view of the electrically operated furnace doors

THE furnace doors were operated by a "pull-up-boy" whose only duty was to stay at his post and operate the control valves when the heater told him to do so. The elimination of this "pull-up-boy" has resulted in a saving of about $1,500 a year.

IN THE early days of making steel the steam engine and the hydraulic cylinder were the two most common sources of power. The steam engine was used to drive such auxiliaries as roll tables on which the power from a rotating engine shaft could readily be used through a simple gear drive. The hydraulic cylinder was used on those auxiliaries requiring a reciprocating motion, such as screw downs, manipulators, shears, soaking pit covers, and open hearth furnace doors.

With the increased application of electric power, the electric motor rapidly supplanted the steam engine, not only because of the many advantages in the transmission and application of electric power, but also because it removed many of the troublesome mechanical difficulties involved in connection with the steam drive. The change over was easily made, in that, generally, it was only necessary to supply the proper pinion on the motor shaft and set the motor in the place occupied by the engine.

The application of the electric motor, with its power available at the periphery of a shaft rotating at high speed, to auxiliaries having a slow, reciprocating motion was more difficult. However, steel mill designers have found various solutions. For example, an electric motor operates the screw down through a revolving nut and threaded screw. Manipulators are operated by an electric motor through a crank drive, soaking pit covers through a rack and pinion, and open hearth furnace doors through a cable attached to a rotating crank arm.

The front of a modern open hearth furnace with the doors arranged for electrical operation and control is illustrated in Fig. 1. Each door is kept in position by guides and is raised and lowered by a single cable attached to a bail and passing over idler pulleys to a small revolving crank driven by a 230-volt, d.c. series-wound, type K3 Westinghouse motor. The five motor-driven cranks, one for each door, are grouped at the rear of the furnace, as shown in Fig. 2. These cranks are driven through a special speed reducer of the worm-gear type with a single spur-gear reduction between the motor and the worm shaft. A type KT, C-H electric disk brake on the motor shaft holds the door safely at any desired open position and prevents slack cable due to motor drift.

The control is of the simplest kind consisting of a dustproof, rugged 9460 type J-2 Cutler-Hammer drum controller designed for reversing service. To open the door the controller handle is moved in one direction and to close the door the controller handle is moved in the opposite direction. Normally, the operator watches the door and returns the handle to the "off" position when the door is opened or closed the proper amount. Limit switches are unnecessary since the only thing that can happen, if the operator leaves the handle in the "run" position, is to have the door open to its maximum opening and then start to close as the crank continues to rotate. The length of this crank arm is such that the door is moved from "open" to "closed" by rotating the crank arm through 180 deg. Continued rotation merely closes the door.

For the sake of convenience and to provide an unobstructed floor space the drum controllers are mounted in an inverted position on a skeleton framework, as shown in Fig. 3. By so doing it has been possible to install them at the edge of the charging floor where they are readily accessible

and can be operated by the "heaters" while watching the doors.

Previous to the use of electric power to operate these furnace doors, hydraulic power was used. The control valves require so much floor space that it was necessary to locate them at some distance from the charging floor. They were operated by a "pull-up-boy" whose only duty was to stay at his post and operate the control valves when the "heater" signalled him to do so. The elimination of this "pull-up-boy" has resulted in a saving of approximately $1,500 a year. The total cost of the complete electrical installation, including hoists, motors, brakes, and controls, was approximately $3,500. It is self evident that the installation will pay for itself in two or three years from this saving.

In cold weather the pipe lines would freeze unless precautions were taken. As a result it was the common practice to place large coke stoves or salamanders at each valve station.

Extremes in temperature do not interfere with the operation of the electrical equipment. Maintenance costs and troubles have been greatly reduced and an accurate and an even control for opening and closing the doors is obtained.

FIGS. 2 AND 3—ELECTRICAL EQUIPMENT CONTROLLING THE MOVEMENT OF THE FURNACE DOORS

At the left in Fig. 2, the equipment is located at the rear of the furnace. The cable from each door comes over above and down behind the furnace to cranks driven by these motors through a specially designed spur gear connected to a worm reduction unit.

Smithsonian Institution Makes Appeal for Information on Exhibition Material

TO STIMULATE public appreciation of the importance of steam power plant engineering the Smithsonian Institution is developing a unit of the National Museum in Washington that will show the most significant steps in the evolution of this branch of engineering science. About 3,000 sq.ft. of floor space with 14½ ft. ceiling height will become available in the next few months and will be used for the undertaking.

It is planned to treat the subject in two parts—one, its history, and the other modern practice. The early history is the history of the steam engine; accordingly a series of models will be constructed to illustrate the progress made from the toylike turbines of the ancients to the engines of Newcomen and Watt. A few models of boilers of the seventeenth and eighteenth centuries will be shown, completing the pre-American history.

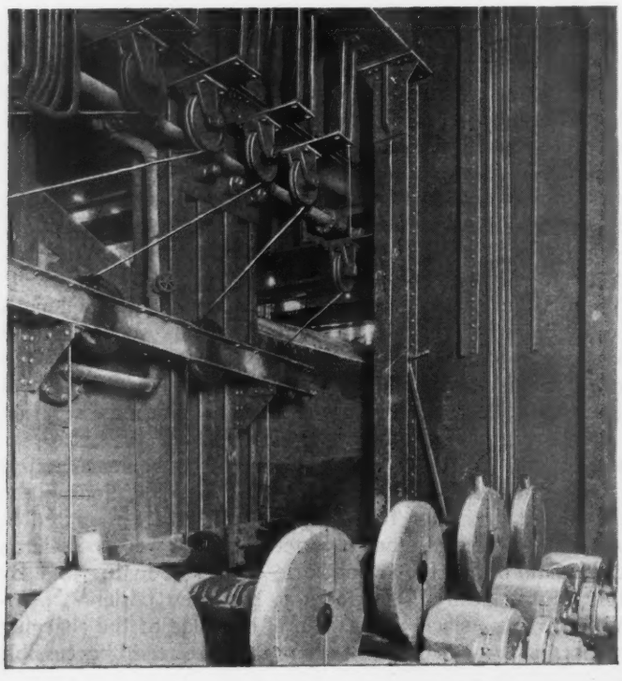
The purely American developments begin after 1755, when the steam engine was first introduced here by Josiah Hornblower. The Institution desires information regarding the location of engines made by Watt, Oliver Evans, John Stevens of Hoboken and Nicholas Roosevelt of New York. Many of these engines were in use and, as it does not seem possible that objects of the nature of a steam engine should not have left a trace, the Institution hopes to locate one or more to complete the exhibit.

The Museum has the only remaining relic of Hornblower's engine, namely, a section of the cylinder, and it is planned to exhibit with the relic a miniature restoration of the engine on its original location.

The Institution makes an appeal for information of any sort relative to the engines of Watt, Evans and Roosevelt; information as to the existence of any steam engines earlier than 1830; of an early Corliss; and of early types of steam engine and boiler equipment.

Watt sold several engines to purchasers in New England. Oliver Evans, our own pioneer engine builder, had by 1815 constructed some fifty engines at his plant in Philadelphia, Pa. His engines were in use in Providence, Marietta, Philadelphia, as well as in the states of Florida, Louisiana and Mississippi.

It would also like to have information regarding appropriate exhibition material for both the historic and the modern parts of the proposed exhibit. Many plant engineers, sales engineers and erection men are aware of power plant equipment that would be suitable and acceptable to the Museum, and many organizations have or might be interested in preparing educational material visualizing modern practice which would be suitable for carrying out the Museum plans.



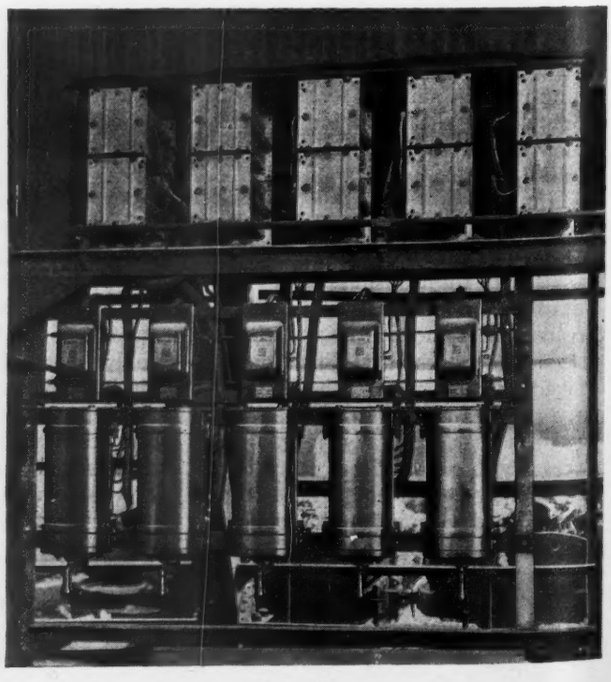


Fig. 1—Supervisor at master board observing movements of watchmen whose reports are automatically recorded on tape.

How the Stewart-Warner Speedometer Corporation maintains supervision over

Fire *and* Watch Service

By J. A. Kaupel
Chief, Fire and Watch Service

SUPERVISION is one of the most difficult problems in connection with handling night watchmen. The only adequate and reliable method of supervision, we believe, is some means whereby all activities of the watchmen are permanently recorded under the observation of a supervisor. In addition, it is advisable to have some automatic check on the supervisor and on the mechanism used. Such is the basis of the system in use. A fire alarm and recording system are also incorporated.

Before going further into the details of our fire alarm and watch system, let us first take up, briefly, some of the plant conditions and the protection against the fire hazards. The plant is a sprinklered, six-story, reinforced-concrete structure 600x250 ft., which is subdivided by firewalls into nine sections, which we designate as buildings, with each given a number. The products manufactured are: automobile accessories, radio sets and other devices. Fire protection is absolutely indispensable, because any lengthy interruption to production would seriously affect practically all automobile plants.

Fire protection must be provided when the building is occupied and also when unoccupied. Gasoline, which must be used for testing and for some cleaning purposes, is the most serious hazard. Both automatic and hand extinguishers are available, in addition to the sprinklers, for both day and night protection. Soda-acid extinguishers of 2½ gal. capacity are placed around all sawdust, excelsior, paper and packing hazards; 2½-gal. Foamite hand extinguishers are at the minor gasoline and oil hazards, and 5-gal. automatic Foamite extinguishers, which are controlled by a Lowe release or a fusible link, are placed above all gasoline, japan, lacquer and paint tank hazards. When the heat rises sufficiently the contents of the extinguisher are automatically dumped into the tank, which smothers the fire. When the hazard

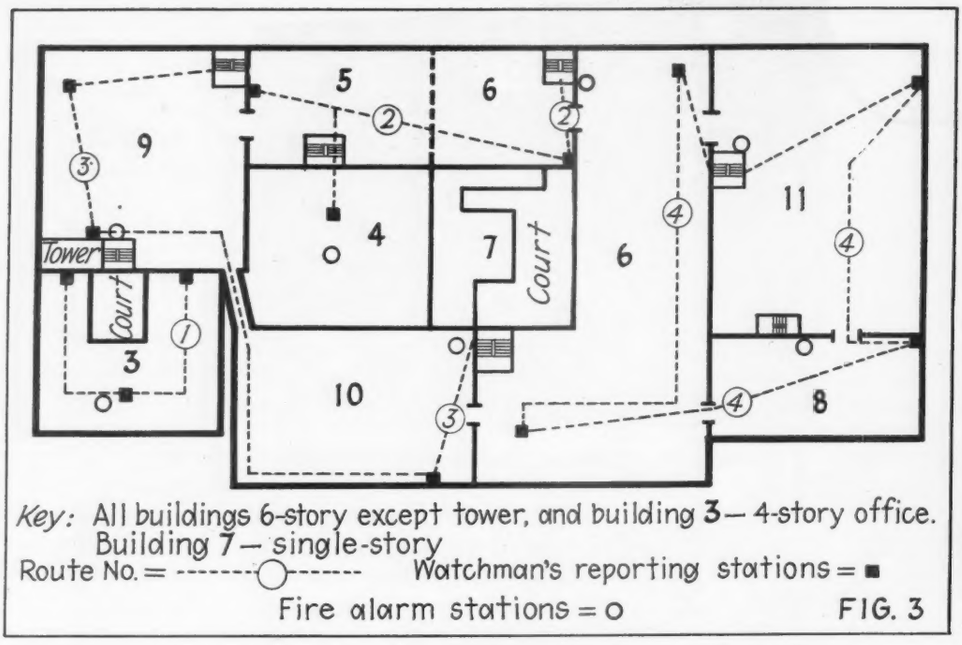


FIG. 2—WATCHMAN REPORTING FROM WATCH STATION
FIG. 3—FLOOR PLAN SHOWING ROUTES AND LOCATIONS OF FIRE AND WATCH STATIONS

The watch boxes are located so that the watchmen must go through a building to get to them. When the watchman turns his key in the box, the coded box number and the time are recorded in one of the recording units *A*, Fig. 1.

is small or where girls, who could not handle the 5-gal. extinguishers, are working, 1-qt. carbon-tetrachloride extinguishers are installed on practically every column. Carbon-tetrachloride extinguishers are inspected monthly and soda-acid and Foamite extinguishers refilled annually, providing they have not been used.

The gasoline is stored in underground tanks and piped to the various floors, but all tanks or vats in the building must be drained back at night. Also, the sweepers work 30 min. later than the shop forces to remove oily waste or wiping rags and any loose combustible material, because obviously, spontaneous combustion is one of the most serious night hazards. Neglect to drain all gasoline containers or remove oily waste and rags, is considered by the company as a very serious offense.

The night watch routes were planned so that the watchman must enter every room and cross to the far side of it. Also, he is not hurried too much; time is allowed for inspection or other tasks. The approximate locations of the watch boxes on the four routes are shown in the accompanying floor plan, Fig. 3, although the arrangement varies slightly on the different floors. The dash line shows the path traveled by the watchman who practically reverses his steps on the next floor below, and so on as he winds back and forth on his way.

A watchman does not stay on one or two floors, but inspects one or two buildings from top floor to basement; thus each watchman travels on all floors. An advantage of this is, because the doors in the firewalls are in line and left open, the watchman can see from one end of the building to the other. On his first round the watchman inspects all doors. Any unusual light, sound or smell in the other end of the building must be reported or investigated. The routes are planned so that about every 20 min. a man passes through a firedoor where he is in a position to look up and down each main aisle the length of the building. If the doors were kept closed, each man could see only his section of the plant, which would be left unguarded until he returned an hour later.

KEY TO INSTRUMENTS ON CONTROL BOARD

A—Watchmen's supervisory recording unit
B—Buzzers for recording units
C—Paging and telephone unit
D—Cut-out and cut-in for elapsed-time indicator
E—Elapsed-time indicator
F—Fire alarm recording unit
G—Dual control
H—Checking sheets
I—Charging panel
J—Trouble bell on fire alarm box and bell circuits
K—Supervisory relays on fire alarm box and bell circuits
L—Master clock

The most important problem, as stated at the beginning of the article, is seeing that the watchmen follow their routes. The supervision we use is a combination of manual and mechanical with an aumotatic mechanical check on the watchmen and their supervisor. Both fire alarm and watch service are recorded on the equipment shown in Fig. 1, which was made by the Auto Call Company, Shelby, Ohio.

The operation of the watchman's supervisory system is as follows: When the watchman inserts his key in any box on his route, Fig. 2, and gives it a quarter turn, the code number of the box is punched in the tape and the date and exact time operated is printed on the tape, as shown in Fig. 4, by one of the three glass-inclosed recording units *A* on the desk, Fig. 1. This furnishes an unalterable record of the watchman's performance.

The supervisor also enters this time on the checking sheet, Fig. 5. A separate sheet is used for each route. As he fills in the checking sheet in front of him, the supervisor can watch the work of each watchman. The tape, meanwhile, winds up when the next box on that route is operated, so, that, if the supervisor leaves his post, he cannot determine

what boxes were operated nor the exact time of operation during his absence. If he tries to guess when he fills in this checking sheet, Fig. 5, any discrepancy will be discovered when the checking sheet and tape are compared. When the tape is perforated, the buzzer *B*, Fig. 1, for that particular recording unit, gives an audible signal.

In this plant, routes 1 and 2, Fig. 3, are traveled consecutively by different roundsmen, so that one recording unit serves both routes. The watchman on route 2 also makes a trip around the outside of the plant every hour. Two men alternate with the watchmen on routes 3 and 4, so that two men are always available for relief, or emergencies, on their hour off.

Telephone jacks are installed in some of the boxes (as indicated by the "T" in the first column of the checking sheet, Fig. 5) so that the watchman can plug in with his portable telephone, Fig. 2, which he carries with him, and report to the supervisor or call for assistance. In addition, the supervisor can call for any or all watchmen on the Auto Call paging unit, *C*, whenever he has instructions, such as to close windows, assist another watchman, and so on.

Automatic supervision over the supervisor is obtained by means of the elapsed-time indicator. At the beginning of the shift the supervisor inserts his key in the cut-in and cut-out control *D*, Fig. 1, for the elapsed-time indicators *E*. This action is coded and timed on the tape and also connects in the elapsed time indicator *E* between the recording unit and the audible paging signals throughout the plant.

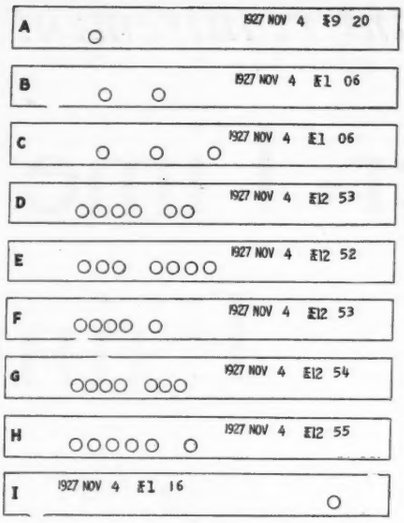


FIG. 4 — EXAMPLES OF CODING TAPE FROM SUPERVISORY RECORDING UNITS

These codes are as follows: *A*—replacing glass case; *B* and *C*—cut-in and cut-out of elapsed-time indicator, respectively; *D* to *H*—codes from various boxes; *I*—removing glass case. Note relative position of code and time stamp as compared to *A*.

In case the supervisor should be held up, suddenly taken sick, become helpless, or leave his post, a buzzer is sounded at the end of a short interval by a timed contact in the elapsed-time indicator *E*, Fig. 1, and, at the end of another short interval, a general alarm is sounded throughout the plant. The sounding of this general alarm is also coded on the tape with the time. This general alarm can be prevented, however.

At the end of the watch shift the supervisor disconnects the elapsed-time indicator by again inserting his key at *D*. This action is also coded and timed on the tape so that he cannot disconnect his supervisory unit without leaving a printed record. This elapsed-time indicator and the necessity of entering the watchmen's time on the checking sheet, Fig. 5, thus keeps the supervisor, or a relief, at the desk constantly. The supervisor receives 1,004 regular reports from the 77 watch boxes in the plant during each 12-hour night shift.

The two extra watchmen, who make alternate rounds on routes 3 and 4, are available for relief of any watchman or the supervisor and are sent to service trouble calls, such as leaking pipes, or other difficulties which would hold up the route man on his rounds. Watch service on Sundays and holidays is performed by inspectors, trouble men, testers and others who work days in this department. These men are paid extra when they take their turn as watchmen. The night watchmen are given nights off without any deductions.

Each watchman carries only a revolver and whistle in addition to his portable telephone. It is unnecessary for them to carry fire extinguishers,

(Please turn to page 574)

STEWART-WARNER SPEEDOMETER CORPORATION

ROUTE 4 BLDGS. 6-8-11 RECORDER NO 3 DATE Nov 9-10, '27

BOX NO.	6:00	7:00	8:00	9:00	10:00	11:00	12:00	1:00	2:00	3:00	4:00	5:00		
2	607	703	759	905	1005	1101	1203	104	208	306	412	453	B6 N. W.	
3T	608	710	813	907	1008	1103	1205	106	211	308	414	456	B6 S. E.	6TH FLOOR
4	612	711	814	908	1009	1104	1206	107	212	310	415	458	B8	
5T	613	713	816	910	1010	1105	1207	108	214	311	416	459	B11 N. W.	
6	616	716	818	913	1012	1108	1210	111	218	314	418	503	B6 N. W.	
7T	618	718	821	915	1014	1110	1212	113	220	316	419	504	B6 S. E.	5TH FLOOR
1-2	619	719	822	916	1015	1112	1213	115	221	317	420	507	B8	
1-3	621	720	823	918	1016	1113	1216	116	223	319	421	507	B11 E	
1-4T	623	722	825	919	1017	1117	1220	117	224	320	422	509	B11 N. W.	
1-5	625	725	827	922	1020	1119	1224	120	227	325	424	513	B6 LAB.	
1-6	625	726								326	426	516	B6 CEN.	
						1150	1251	154		358	443	543	B8	FLOOR
1-2-2	652	756	854	956	1046	1151	1253	155	253	359	444	545	B11 N. W.	
1-2-3	654	758	856	958	1049	1154	1253	157	254	401	447	547	B6 N. W.	
1-3-1T	656	800	857	958	1050	1155	1256	159	256	403	447	548	B6 S. E.	
1-3-2	656	801	858	959	1051	1156	1256	200	257	404	447	549	B8	BASEMENT
1-4-1	657	802	859	1000	1052	1157	1257	201	258	408	448	550	B6 N. E.	
1-4-2	659	804	900	1002	1053	1159	1258	203	300	410	449	552	B11 E.	
1-4-3T	700	805	901	1003	1054	1200	1259	204	300	410	450	553	B11 N. W	
OBSERVER	Trull	Bassett												

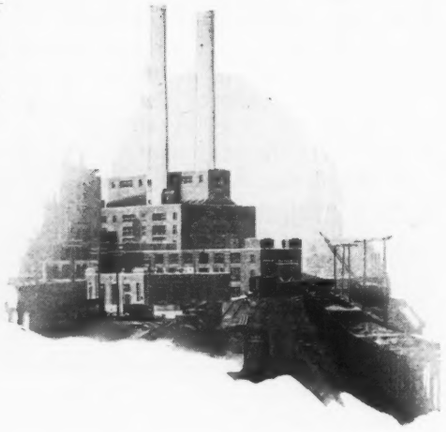
REMARKS

FIG. 5 — PORTION OF CHECKING SHEET ON ROUTE 4

This sheet is filled in by the supervisor from the record as entered on the recording tape by the two watchmen, who make alternate rounds on this route. The letter *T* in the first column indicates that a box has telephone connections for the portable sets carried by the watchmen.

The most important requirement of

Winter-Time Painting



is to have the surface in the proper condition

—writes

F. E. Gooding
Associate Editor
Industrial Engineering

MAINTENANCE painting in industrial plants is usually planned so that outside surfaces are painted during warm weather and the men are moved to inside work when it turns cold. This is an ideal arrangement because the personal comfort of the men is a serious drawback to any outside winter activity, such as painting either by hand or air brush, which require the movement of hand or fingers. Also, advantage is taken of the weather which, in summer, dries both the surface to be covered and the freshly applied protective coating more quickly than in winter.

Whether painting of outside exposed surfaces is practicable in winter depends entirely upon the surface and on climatic conditions. For example, painting in sections where the weather is warm during the winter should be satisfactory except, perhaps, as rainy seasons may affect the surface. Some railroad companies paint rolling stock the year around. Their problem, to a large extent, is quite similar to that of the average industrial plant.

Practically all of the common paints are a mixture of an oil, such as linseed or china wood, a pigment for color, and lead oxide or some other material to give it body. As the oil oxidizes it forms a hard protective covering. The rate of oxidation increases with the temperature. Some paint manufacturers do not recommend painting when the temperature is below 65 deg. F. This is largely because of the necessity of using thinner and dryer for hand brushing at the low temperature. Also, paint requires about 48 hours to dry with ordinary temperatures and longer according to the decrease in temperature. At temperatures below freezing the oxidation action is dormant. Linseed oil has a freezing point of 18 deg. F. below zero.

Certain requirements govern all painting, irrespective of the season, and when these facts are understood, and paint is applied accordingly, the success and lasting qualities of the protective coating may be assured.

The most important of these requirements is to have the surface in the proper condition. Removing dirt, rust, using filler when necessary, and other surface treatments are always preliminary to all painting, irrespective of the season, and so will not be discussed here. There are, however, a number of conditions to be observed in connection with painting which are influenced by seasonal or climatic conditions. The most important of these is to have a dry surface.

When paint has been applied over a surface containing moisture, the application of outside heat, either from direct sunlight or during the summer, will "bring out the moisture" and in doing so, it simply pushes the paint away from the surface. If the surface contained a considerable amount of moisture, practically all of the paint will come off; if the moisture content was small or concentrated, the paint forms "blisters" at those spots when the weather warms up.

Winter painting is not analogous to winter building. The sand and water for mortar are heated and are used in sufficient volume to retain this heat long enough for the mortar to set before freezing. Paint cannot be heated above normal summer temperature and also it is applied in too thin a coating over a cold surface for this heat to have much effect. One of the accompanying illustrations shows a type EM DeVilbiss heater attached to a paint container, which sets in a hot water bath. This heater is used for outdoor winter painting and also in unheated buildings.

Painting Absorbent Surfaces

Absorbent surfaces, such as brick and concrete, are seldom free enough from frozen-in moisture to risk winter painting. These surfaces are difficult to dry out and, after a warm day, frequently condense and regain sufficient moisture at night to interfere with paint applied the next day, particularly if the work is done before the walls are warmed up by the sun, or on a north side of a building which does not receive any direct heat from the sun.

Considerable care must also be taken to see that absorbent walls are

fairly dry before painting on the inside. For example, a concrete wall which is waterproofed or dampproofed on the outside can be painted satisfactorily on the inside in the winter time if the building has sufficient heat to dry out the concrete wall. If the outside is not waterproofed or dampproofed and the building is heated after painting on the inside the heat sometimes "draws" the moisture toward the paint and "pushes" it off the wall. The remedy with porous walls, is to first waterproof or dampproof the outside and then thoroughly dry the wall by heating it from the inside before painting. Water- or dampproofing coatings, which have a cold water base, cannot be applied during freezing weather.

When new buildings are erected during cold weather the mistake is sometimes made of painting inside plaster and tile or cement walls while yet "green," that is, before the building is thoroughly dried out. The same precaution is necessary in warm weather but then the walls dry out much more quickly. The danger in winter lies in mistaking surface drying, such as may result from too high a drying temperature, for a thorough job. Similar precautions are required when painting the interior of unheated warehouses or other buildings.

Wood offers an absorbent or non-absorbent surface according to the condition of the paint coating previously applied or if unpainted. However, there are many instances of successful application of paint to such cases. The experience at one plant indicates the possible danger of improper application.

During a warm period in a so-called dry winter the manager of one factory ordered the painting of a new, unpainted wooden building. The next spring the east, south and west sides of the building were entirely satisfactory with the exception of a few spots. Practically all of the paint on the north side however, blistered or peeled off. The same kind of paint had been used throughout; therefore, the material was not responsible.

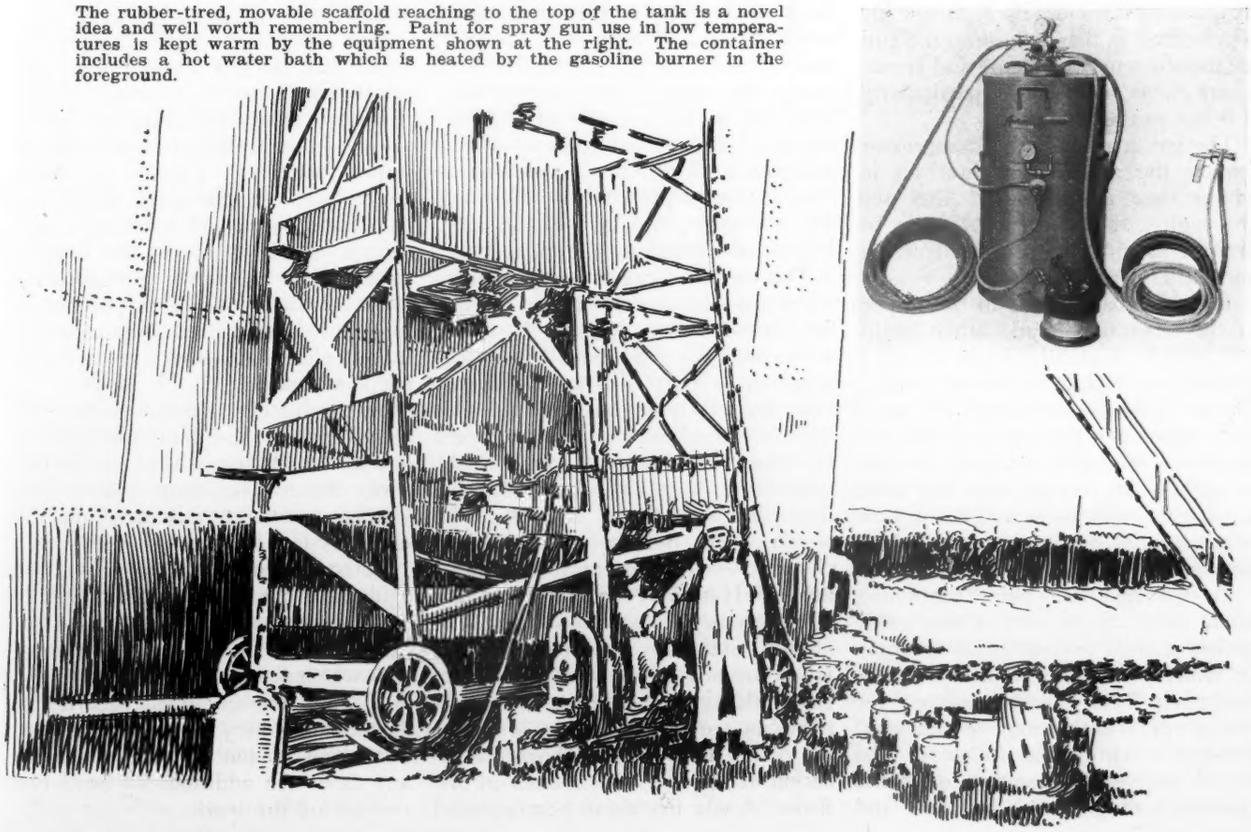
The theory advanced by the paint service engineer who was called in, was that during the day the sun had dried the three sides of the building sufficiently to permit satisfactory painting. The north side, warmed up only enough to condense moisture from the air which would freeze again at night. If the surface has been well protected with previously applied coat of paint and only a new coat or color change was desired the work would probably have been satisfactory on all sides of the building. A wooden surface, which is badly in need of paint, may absorb sufficient moisture to affect the lasting qualities of the paint, when the moisture dries out.

Dry, metallic and other non-absorbent surfaces can be painted in cold weather with the least chance of unsatisfactory results. However, a metallic surface which has been painted once is less likely to be damp from frost or moisture condensed from the air. The difficulty comes in connection with applying the paint, which stiffens with low temperature. Even 10 deg. F. will make a difference in ease of application by the use of the hand brush.

Assuming that it is a hand brush job paints will "drag," or "crawl." A thick paint "drags," that is, it is too stiff to brush onto the surface and drags, which increases the difficulty of hand application and often results in an uneven coating. Where the paint is thinned to prevent drag it sometimes "crawls," that is, it is so thin that it will gradually flow as a surface, or crawl by gravity. This also results in an uneven application. Paint when applied in a thick coat by an air brush is also likely to crawl because the attraction of gravity is greater than its adhesion power before it begins to set, which takes place slowly because of the low tempera-

FOUR BELOW ZERO! THE SPRAY GUN IS BEING USED TO PAINT THESE OIL TANKS IN WYOMING

The rubber-tired, movable scaffold reaching to the top of the tank is a novel idea and well worth remembering. Paint for spray gun use in low temperatures is kept warm by the equipment shown at the right. The container includes a hot water bath which is heated by the gasoline burner in the foreground.



ture. To prevent crawl the painter usually adds some quick drying agent.

Some climatic conditions and geographical occasions are better suited for cold weather painting than others. For example, painters in parts of Canada and the United States, particularly those sections which have dry summers, and "dry cold" winters report successful paintings of large areas when the temperature is below zero. One of the illustrations accompanying this article shows a painting scaffold on wheels which was used to paint oil tanks in Wyoming with a Paasche air brush when the temperature was 4 deg. F. below zero.

If sufficient area is to be covered to make mechanical painting worth while such equipment can be used as well in winter as in any other season. A thicker paint can be better applied mechanically than by hand. The only difficulty which may interfere with the use of the paint spray is in connection with the condensation of moisture in the air compressor, receiving tank and the hose line. The moisture which forms in the air receiver may be removed by opening the valve in the bottom and "blowing" until the air seems to be dry. Also, it is advisable to place an air conditioner between the air receiver and the paint container to prevent condensation in the main air hose. Unless the moisture is removed the regulators may freeze. If moist air is permitted in the air hose to the gun the moisture may condense and freeze in low spots in the hose, particularly if it lies on the ground.

The gas engine and air compressor require the use of a lighter oil in winter than in summer. Also, the gas engine, if water cooled, must be drained at night to prevent freezing and bursting the jacket.

Professional painters in the region of the Great Lakes and other localities which generally have a damp atmosphere during the winter hesitate to do outside work except of small areas when the day temperature gets as low as 40 deg. and below freezing at night. These men have had wide experience with paint and know how much thinner or dryer can be added for each particular condition.

It is stated that paint containing about 20 to 28 per cent of zinc oxide makes a good outside paint to apply in winter. Another mixture, which was given by a practical painter, for use on surfaces that may be somewhat frosted or damp is as follows: The liquid or vehicle consists of equal quantities of gloss oil, kerosene and linseed oil. Equal quantities of metronite and white lead are mixed in the vehicle to the desired consistency. Metronite is in powder form. It is stated that this paint has been used successfully in Michigan in cold weather, has good lasting quality, and is low in cost.

The average industrial painter, however, will usually find it to his advantage to postpone extensive painting projects until warm weather and do inside work. However, on bright days hydrants, downspouts, window sash and a wide variety of small paint jobs can be finished with satisfactory results. It is better to paint such surfaces in winter than not at all; but for protection against the elements, new work requires a priming coat or two. When warm weather comes the painter will soon learn whether it is going to stick and he can then brush off the loose particles and finish the job.

Fire and Watch Service

(Continued from page 571)

which are available in all parts of the plant. An extinguisher would be an unnecessary load, even though only able-bodied watchmen are used.

The automatic recording unit *A*, Fig. 1, is motor-driven and has automatic supervision. The circuits on which the watchmen report, are normally closed. In case a circuit should open, the tape runs continuously. This can be stopped only after opening the glass case and throwing a control switch which lights a red lamp as long as the trouble exists. Opening the case is recorded by a special code, Fig. 4, and timed on the tape.

The watch service is for protection when the plant is unoccupied. The fire-alarm signal system, however, serves both day and night. The watchmen may report fires to the supervisor by telephone, but we urge that the fire alarm boxes and alarm system be used. There are 40 red break-glass-front Auto Call alarm boxes in the plant on seven circuits. The watch boxes which are blue, are placed where they are more difficult of access. However, the fire alarms are conspicuously located at exits, elevators, stairways or passageways, where usually they are convenient to two buildings and where every workman can see them as he passes in or out of his floor. Fig. 3 shows the location of the fire alarm boxes on one floor. A city fire alarm box is placed on the street outside the watchmen's headquarters. Also, a direct line to the telephone exchange enables the supervisor to report a fire by telephone.

When a fire alarm box is put in operation, by breaking the glass front with a hammer, the fire signal recording unit *F*, Fig. 1, perforates the box number on the tape and prints the date and time similar to that on the watchman's tape, except that it is repeated three times. A sufficient length of tape is exposed so that the record is not covered up, as is the case when the watchmen report at a watch box. Simultaneously, the Auto Call paging system is automatically cut out by the dual control unit *G*, Fig. 1, and ten rapid signals sounded throughout the plant to indicate that a fire call is coming. This is immediately followed by the code number of the box, repeated three times. The dual control unit *G*, through the relays, also cuts in the fire-only circuits for the alarm.

This dual control is operated by a clock spring. However, when the spring is dissipated to a certain point, a special trouble signal sounds on a bell until the spring is wound.

A trouble bell on the fire alarm box circuits indicates any failure or interruption of the power source by opening a relay which cuts in the 110-volt, 60-cycle lighting circuit, to operate a trouble call.

Fire alarm box circuits, the night watch box circuits and the fire-only signal circuit, are all normally closed and supervised and supplied from either of two banks of 48-volt Exide storage batteries. Usually one bank of batteries is charging while the other is in use, but if necessary, connection can be made to the battery under charge and the Tungar rectifier floated on the line. This practice is to be used only in emergencies because a slight hum interferes with the telephone service.

As a further check on the fire alarm circuits and box mechanisms, one or more boxes in each of the seven circuits are operated daily. By selecting a different box each time, the entire system is operated every week.

Although this watch and fire alarm equipment has been in operation only a short time, we can see a decided improvement in the service and interest the watchmen take in their work. Also, we feel an added security in that we know very closely where every watchman is and can locate him at any time. In addition, we have two records of his work.

A Link-Belt 30-in. belt tripper

How the improvements claimed in the application of

Roller Bearings to Conveyors...

are actually secured

Explained by
S. M. Weckstein
Industrial Equipment Engineer, Timken Roller Bearing Co. Canton, Ohio

SINCE conveyors, of all types, have proved themselves the most efficient, and are consequently the most used medium for handling certain classes of bulk materials, they have naturally been brought to a high state of development, both physically and mechanically. Nevertheless, certain problems in connection with their design still remain, the solution of which has a decided influence on their performance from both a practical and an economic standpoint. And while many of these problems arise out of the particular conditions under which individual conveyors must work, which vary so much that usually they have to be solved according to the requirements of each particular case, there is one problem which is common to all cases—that of obtaining the greatest amount of work per unit of power input.

This problem assumes the proportions it does because conveyors of any type whatsoever represent, from a driving standpoint, primarily a friction load to a degree that may be aggravated, but is seldom lessened by any one of many factors that may be encountered in service. A brief summary of these would include: the type of conveyor; the sort of material handled; the distance traversed; the conditions of loading; and the convenience and frequency of lubrication —the latter of which is usually dependent upon the former.

Many methods which met with varying success have been tried in the effort to reach a satisfactory solution of the problem, but few of them have proved really satisfactory. Comparatively recently a remedy has been adopted which attacks the trouble at its source—the application of antifriction bearings to the conveyor rolls, and drive mechanism. The results have been remarkably successful especially from the standpoint of improved operating practice and economy, sufficiently so at least to thoroughly establish the practicability of the method. For this reason it might be of interest to consider the engineering features of the application of the bearings to different types of conveyors, inasmuch as it is from such a description that the best idea can be obtained of how the improvements claimed are actually secured.

Since belt conveyors are the most widely used, and also present the most difficult problem in so far as their drive is concerned, it is logical that they should have been the first to receive attention. From a construction standpoint the application, especially of tapered roller bearings, to the rolls is a very simple matter, the only important requirements being that ample provision must be made for the

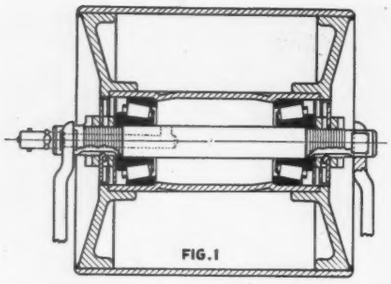


FIG. 1

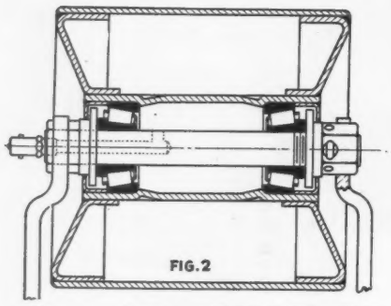


FIG. 2

FIGS. 1 AND 2 — TYPICAL BELT CONVEYOR ROLLER APPLICATIONS

The bearings are mounted in a tube or shell, which carries the body of the roller and which is constructed so as to form a perfectly dust-tight and leak-proof reservoir for the lubricant. Fig. 1 shows one form of bearing mounting and the method of retaining the lubricant. Another type of mounting employing a simpler method of retaining the lubricant is shown in Fig. 2.

storage of enough lubricant to last over a considerable period, and that the possibility of the entrance of dirt or other foreign matter into the bearing housing must be eliminated as nearly as possible. Although the actual details of such construction are usually a matter that is decided upon by the conveyor builder, experience has developed a more or less conventional sort of construction that will serve to illustrate how the requirements are met.

As can be seen from Figs. 1 and 2, which are typical rollers, the bearings are mounted in a tube, or shell, which carries the body of the roller, and which is constructed so as to form a perfectly dust-tight and leak-proof reservoir for the lubricant. The cups or outer races of the bearings are usually pressed into the tubes, and the cones given a slightly loose fit on the shaft, but not so loose as to permit any slippage.

By virtue of this construction, not only is shaft wear prevented, but there is no likelihood of the bearing seizing, and causing the roller to wear spots on the belt. Lubrication in most modern installations is accomplished by the grease pressure method, the roller shaft either being counter bored, or left hollow, to permit access of the grease to the interior of the tube. There are various ways of constructing the outer closure, both simple and complex, but in either case it is easy to work out an inexpensive method that is highly effective, such as the use of labyrinth washers, for example.

In the case of the larger rollers, concentrator rollers, return idlers, or others where for various reasons it is impractical to use the whole interior of the tube for holding lubricant, a different arrangement has been adopted which is shown in Figs. 3 and 4. In these two cases the tube mounting of the bearings is dispensed with, the roller being so constructed that the bearing cups can be pressed directly into the end frames, which are so designed as to form an inside seal for retaining the lubricant in the bearing chamber. The method of introducing the lubricant is the same—by boring and counterboring the shaft to afford a passage from the exterior to the reservoir. As a usual thing, the exterior closures are of the same construction as in the other rollers. An extra precaution is sometimes taken to seal the lubricant more positively in the lower bearing of concentrator rollers.

In the case of some flat-belt return rollers, where the tube bearing mounting is retained, the lubrication reservoir space is provided for by a large punched steel stamping or retainer, which fits closely around the shaft,

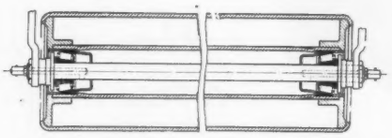


FIG. 5 — FLAT BELT RETURN ROLLER SHOWING MODIFICATION OF TUBE MOUNTING

The method of supplying the lubricant is the same as that shown in Figs. 3 and 4.

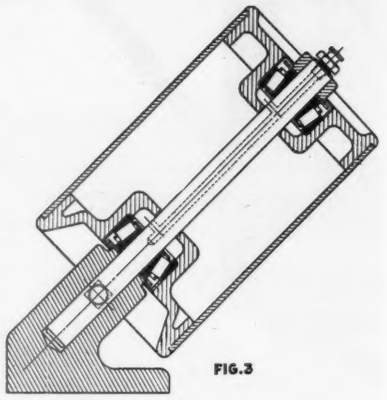


FIG. 3

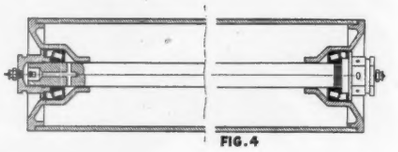


FIG. 4

FIGS. 3 AND 4 — BEARING ARRANGEMENT ADOPTED FOR LARGE ROLLERS

In these two cases the tube mounting of the bearings is dispensed with, the roller being so constructed that the bearing cups can be pressed directly into the end frame. The method of providing lubricant storage space around the bearings for concentrator rollers or belt conveyors is shown in Fig. 3. A flat belt return roller with bearings mounted in the web extension is shown in Fig. 4.

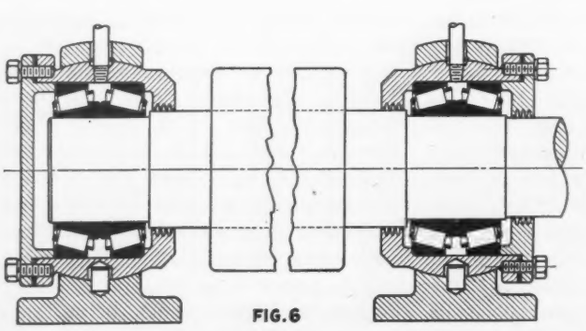


FIG. 6

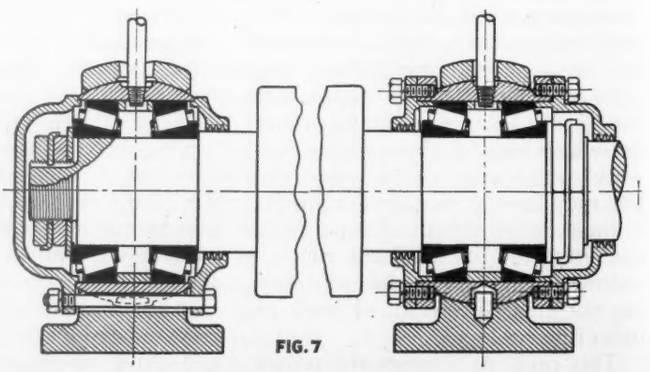


FIG. 7

FIGS. 6 AND 7 — METHOD OF MOUNTING HEAD OR TAIL PULLEY BEARINGS

Back to back mounting of the bearings is shown in Fig. 6. In Fig. 7, the cups are held apart by a spacing ring. The inside bearing is mounted against a fillet on the shaft, but the outside bearing is properly set up by locknut and washer.

and is pressed into the shell ahead of the bearing cup. This construction is shown in Fig. 5. The method of supplying the lubricant, however, is the same.

The practical reasons for these modifications are easily explained. In the case of concentrator or guide rollers the position in which they are mounted makes it necessary, aside from any consideration as to the mechanical advisability of tube mounting, to provide means for concentrating the lubricant in the immediate vicinity of the bearing to be supplied. Otherwise, the upper bearing would tend to run dry, and the lower would be over-supplied. In the case of return rollers, whether the bearings are tube mounted or not, the volume of the interior renders it impractical to use the whole space as a reservoir because of the waste of lubricant that would result.

Load Characteristics

In order to obtain the fullest benefit from the use of anti-friction bearings in belt conveyor practice, however, the installation should not stop with the conveyor rollers, but should include the head and tail pulleys, take-up pulleys, etc. As can be seen from Fig. 6, the bearing arrangement in the case of the former differs considerably from that found in the conveyor rollers and return idlers, the variation being due principally to the difference in the load characteristics and requirements of the two types of installation.

Since in the latter instance the loads, both radial and thrust, are much heavier, and the matter of holding the shafts in alignment assumes greater importance, it is customary to use two bearings, mounted back to back at each end of the shaft. In some cases they are mounted as shown in Fig. 7, that is, with the cups held apart by a spacing ring, and the cones a light press fit on the shaft, the inside bearing being mounted against a fillet on the shaft, and the outside one properly set up by lock nuts and washers. In other cases they are mounted directly back to back without any spacer, the cones being a metal to metal fit on the shaft. In this case any floating of the shaft that becomes necessary can take place through the cones without disturbing the bearing adjustment. In both cases the bearing housing is of very simple construction, and the facility for storing the lubricant is ample.

As far as take-up pulleys are concerned, they are usually mounted between two pillow blocks, in which the bearings are mounted so as to give the greatest possible rigidity to the pulley shaft. Fig. 8 shows a typical mounting of this sort. A standard pillow block, such as can be obtained as a complete unit from the manufacturers, is used in this case. The bearings come properly set up, and it is only necessary to locate the sleeve in the proper position on the shaft, and clamp it in place by the nuts provided for the purpose. The pedestal which holds this pillow block can be designed to provide for the automatic take-up on the belt.

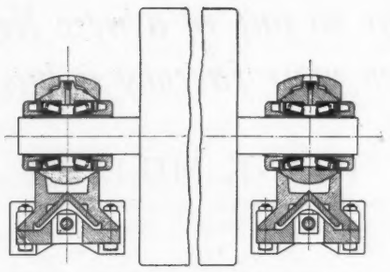


FIG. 8—TYPICAL BEARING MOUNTING FOR TAKE-UP PULLEY
The bearings are mounted so as to give the greatest possible rigidity to the pulley shaft.

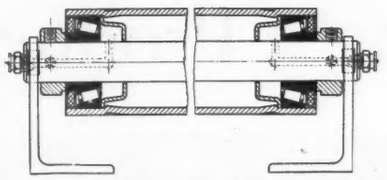


FIG. 9—TYPICAL BEARING MOUNTING FOR GRAVITY CONVEYOR ROLLER
One of the most important mechanical features of this type of application is the necessity for simplicity, and correspondingly low cost in equipping the rolls with bearings.

Before leaving the subject of belt conveyors, a type of conveyor should be considered that is closely allied to them, at least as far as the roll construction is concerned, namely, the gravity conveyor. Mechanically, one of the most important features of this type of application is the necessity for simplicity, and for correspondingly low cost in equipping the rolls with bearings.

This necessity arises from the great number of rollers that must be used, in proportion to the length of the conveyor, which would make an expensive form of mounting impractical. Consequently, a very simple method has been worked out, which is largely used, as shown in Fig. 9. It consists of pressing a circular indentation into the roller itself, which provides a shoulder on the inside surface of the roller against which the bearing cup and the grease retainer can be pressed. The outer closure is formed by labyrinth washers, and the whole assembly locked in place by a retaining ring which is held by a set screw. The lubricant is supplied through holes in the shaft similar to those formerly described.

Physical Features

In the case of flight, pan, or apron conveyors, as they are variously known, the physical features of the installation are naturally quite different, as are the load requirements, as far as the bearings themselves are concerned. The same factors concerning lubrication remain, however, in that provision must be made for a supply sufficient to last over long periods. Because the bearings are usually mounted on wheels which are flanged to run on tracks, the thrust loads which are always present in such a combination become an important factor in applying the bearings.

Several methods of mounting have

(Please turn to page 591)

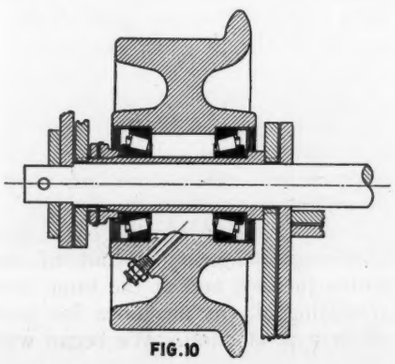


FIG. 10

FIGS. 10 AND 11—SIMPLE FORM OF BEARING MOUNTING FOR CONVEYOR WHEELS
The bearing mounting for pan conveyor wheels is shown in Fig. 10. The cups are installed in the usual manner, but the cones are set up on a sleeve. The whole comprises a unit assembly of wheels and bearings. The assembly shown in Fig. 11 is different, in that the cones are fitted directly on the shaft. It does not permit of unit assembly such as that illustrated in Fig. 10.

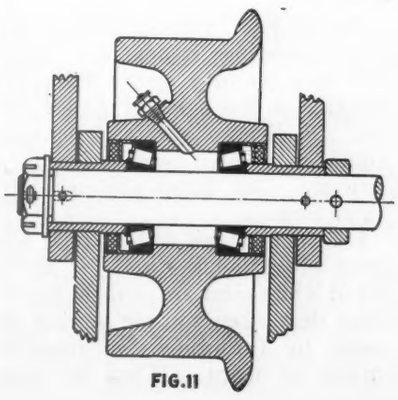
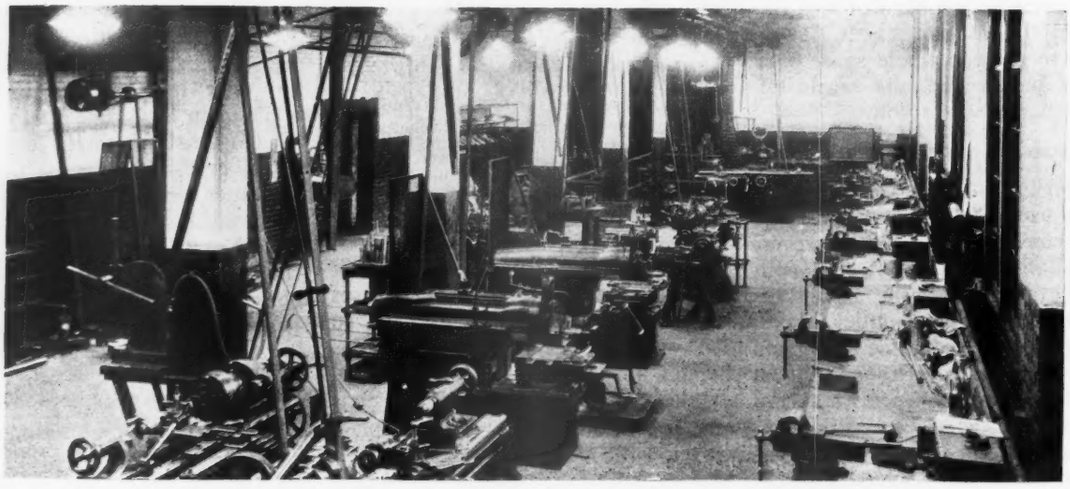


FIG. 11

The best time to put in a new lighting system is when your factory is busy, says

FRANK MILLHOF
Superintendent, Leece-Neville Co., Cleveland, Ohio

Revamping the Lighting System During a Production Peak



General illumination replaced local lighting by drop cords in this tool room

OUR plant is engaged in the manufacture of commercial automotive starting and lighting equipment and voltage-regulated lighting units that are used both by the Government and by industrial plants, railroads and other organizations. I had realized for some time that our lighting was insufficient for a product that had to be made with such accuracy as ours. In particular, the requirements on the outfits supplied to the Government are very strict.

Formerly it was considered that good appearance is not very important in a machine shop. Everyone expected to see a lot of grease and dirt. A light, clean machine shop would have been something of a curiosity. But things are quite different now.

I do not believe that there is any place where lighting and the liberal use of white paint are of more importance than when you are serving the public by furnishing equipment or service of merit. When an army officer, a navy officer, bus operator or railroad official comes in he likes to see everything as clean and orderly as it is in the barracks, on board ship, or in a parlor car. There is nothing that contributes to neatness and orderliness in the way that proper combination of light and paint does. When there is a dark corner or a dark place under a machine, you can be sure somebody will take advantage of it sooner or later as a safe and easy place to throw rubbish or sweep dirt. We have eliminated all such places in our plant. There is not a square foot of floor space that cannot be seen, except where it is taken by a machine that goes right down to the floor of the building.

We had used overhead illumination from the beginning, but the units were small; so we had drop cords everywhere. There was a regular forest of lamp cords and they were always causing trouble. Frequently they got caught in the gears on the machines and were short-circuited, or somebody would pull one a little too hard and break it. Furthermore, in spite of the guards, a great many lamps were broken in the course of a year, which increased the cost of maintaining the lighting system.

A little over a year ago I commenced to look around for a solution, and decided that the only thing to do was to rearrange the machines and clean out all the drop cords in favor of better overhead lighting. At that time we were in the middle of a production peak.

All our machines were busy every minute of the day. However, I believe that the time to make changes in your factory is when you are busy. If you need those changes to produce an extra volume of work, the sooner you make them the better. Besides, it is always easier to put through an improvement when there are plenty of orders on the books.

So I started in on that basis, first obtaining a lighting layout of the entire factory, and at the same time relocating all the machines for most efficient production. We began with

the tool room and put in a lighting system that gives the workmen 19 foot-candles at the level of the bench. In spite of the fact that this department is right up against the windows, the lights are on all the time except on bright, sunny days. We do have some exceedingly fine work, such as cutting a fine and accurate thread or splitting a line in making a die, for which a relatively high level of illumination is required, but only over the small area in which the actual work is done. In these special cases we use a few local lights, but for the vast majority of our operations the present system gives much better results than anything we have ever tried.

The tool room lighting system was put in on a month's trial, but there has never been any question of going back to the old method of lighting. Just as soon as the installation was completed, men in other departments began to ask, "Why can't we have that kind of lighting in the machine shop?" or "Why can't we have such lighting in the repair department?"

Most of the men took to the new lighting from the start. Occasionally I found one who said he preferred a bare lamp hanging before his eyes all the time. In such cases I would ask him to let me make a little test and called one of the other men over. I would ask him to let the light shine in his eyes a few seconds, and then look away from it. Then I asked the man who wanted the drop light to watch the pupils of the other man's eyes while this test was going on. Of course, he saw them close down in the light and open up when he looked away. I just reminded him that this continuous changing of the pupil all day long was extremely tiring, and bad for the eyes. No one failed to appreciate this fact and now everyone is entirely satisfied to work by the general lighting system.

As I have mentioned, we made all of these changes at the busiest time in our history. And we did it without making a ripple in the routine of our production. Practically all of the moving was done at night. A machinist would leave his lathe in one spot at night, and find it at the other end of the shop in the morning. The new lighting system went in just as smoothly. We did not remove any of the old wiring until we had all of the new wiring in and ready for current to be turned on. We went through several of our departments in the same way. All the new units consist of Glassteel reflectors fitted with 200- or 300-watt Mazda lamps and are spaced 10 ft. apart. The mounting height is 9 ft. 6 in. This arrangement gives an intensity of 14 foot-candles, which is used in all of the production departments.

At the present time we are making a considerable addition to our plant, but we are not letting that alter our plans in the slightest degree. I know where every lighting unit in the plant will be placed and we can go ahead any time and equip those sections that require immediate attention. No matter how much or how little lighting equipment is added at a time, I know that it will fit perfectly into the general plan.

There are two points that I should like to pass on from my lighting experience. The first one is: The best time to put in a new lighting system is when your factory is *busy*. There is no such thing as being too busy to give employees the benefit of better lighting. The second suggestion is: Plan your entire lighting installation at one time, so that you know where every lighting unit is to be. Then, no matter where you start, or how many units you install at a time, every one will fit into the general plan. This procedure will save the trouble and expense of moving units later.

A GENERAL VIEW AFTER THE NEW LIGHTING SYSTEM WAS INSTALLED

The Glassteel reflectors containing two 200-watt lamps are spaced 10 ft. apart at a mounting height of 9 ft. 6 in. The intensity of illumination is 14 foot-candles.

New Welded Truss Member Uses Less Metal

UTILIZATION, at less expense, of less metal to withstand a given load in the construction of industrial buildings is made possible by the development of a new design of roof truss by William Dalton of the General Electric Company's manufacturing department. This truss, instead of being riveted, is fabricated by welding.

The truss consists of two parallel lengths of metal latticed together by a system of tension and compression members, rivets heretofore being used to fasten the units together. The use of rivets, however, necessitates punching holes in the truss members, and these holes cause a waste of material. This loss, says Mr. Dalton, is equivalent to a strip of metal the full length and thickness of the part in which the hole is punched and as wide as the diameter of the rivet which is used.

In the new truss, the two parallel members or cords are made of H beams; the tension members are of channel iron and the compression members, H beams. As an economical fastening is needed and as it is not easy to rivet such a combination of shapes together, welding is used to make the necessary connections. This also avoids the waste of metal caused by rivet holes, and furthermore does not require the use of gusset or connecting plates necessary for riveted joints.

A long series of tests has proved that a definite size of weld of a given length made with a specified current and electrode has as definite and dependable holding value as an ordinary rivet.

A comparison of riveted and welded trusses designed for the same load and stresses shows that the riveted trusses are about 40 per cent heavier than the welded trusses.

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with which is consolidated
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Buying According to Specifications Can Be Overdone

PURCHASING materials and supplies according to carefully prepared specifications seems to be a growing tendency in industrial plants. The establishment of such quality standards is a commendable practice and its extension is well worth considering. However, like with many other practices and policies, this feature of purchasing is being overdone in some cases. Also, as is almost inevitable when specifications are prepared at individual plants, there is comparatively little co-ordination in requirements.

This is pointedly emphasized by data compiled by a belt manufacturer. Approximately twenty of his customers have prepared their own belt specifications. Of these, no two are exactly alike in their requirements. Some have specifications which vary so slightly from the characteristics of the standard belt made by this company that it would require more careful tests than the average user could make to determine whether their requirements were complied with. Still other specifications impose changes in the manufacturing methods, some of which the manufacturer believes do not give any appreciable increase in quality but increase the cost and add to the inconvenience that always accompanies special orders.

The manufacturer would unhesitatingly guarantee his regular first-quality product for the ordinary requirements of his customer. But as each of these customer's specifications is designed to obtain simply a standard first-quality belt, the manufacturer properly feels that he cannot offend the laws of economics by getting out something "a little different" for them when standard goods will apply.

Manufacturers of lubricants, paints and numerous other supplies used in industry are confronted with similar "home-made" specifications. In several cases, due to error in analysis or to a lack of technical or manufacturing knowledge, the specifications have contained conflicting or impossible requirements. In some instances a product compiled according to the specifications would not be at all similar to what is wanted.

Analysis and testing of belts, lubricants, paints and a number of other industrial supplies require not only special laboratory apparatus but a technic which can be obtained only through experience. The small industrial user must rely upon the recommendations of manufacturers. He establishes a contact with a reliable maker and buys standard, which are usually branded, goods. In many ways the quality and usefulness of the supplies he buys are better assured than are those of the buyers who attempt to tell manufacturers with long experience in special lines how to make their product. Where specifications are necessary, standards, which can be used, have been prepared by the Bureau of Standards, the associations of the manufacturers or other bodies, after due investigation of the problems of both manufacturer and user.

Do Your Men Know What to Do In an Emergency?

WHEN the recent flood in New England suddenly swept over one large plant on a Saturday evening, the confusion among the few men on duty can easily be imagined. All employees who could be reached by telephone were summoned and in a very short time every precaution that could be thought of was being taken to minimize damage. Although a most creditable job was done, considering the circumstances, it is only natural that some things should have been overlooked. One of these items was a number of large cans of calcium carbide.

This company has a central acetylene generating plant and the raw material, carbide, was stored in a supposedly safe place. In the excitement no one thought about the cans of carbide until a strong odor of acetylene gas showed that the water had reached them.

Removing these cans to a safe place was a difficult and dangerous job. Despite the fact that some were so hot they could hardly be touched, the workmen had to carry them in their arms to a safe place. Luckily, no one was injured, although the chances in favor of a serious accident would seem to have been great.

As a result of this and other lessons learned during the flood, the plant engineer purposes to write down a detailed list of the things to be done in the event of another flood. These jobs will be set down in the order of their importance.

This plan could well be adopted in almost any plant. Although a great many plants, fortunately, are in little danger of floods, fire is an ever-present menace in all plants. In many others, processes that employ high temperatures, or pressures, or in which explosives or inflammable liquids are used, may present definite and serious hazards.

Concise directions telling just what to do in an emergency will go a long way towards minimizing damage, and insuring intelligent direction of efforts.

© Galloway

©Wide World

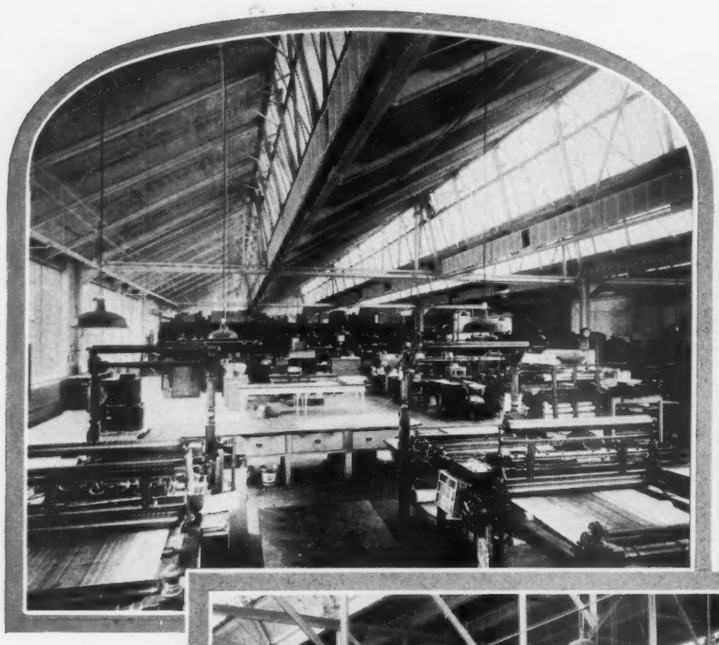
Take a Tip From These Fliers

OVERSEA fliers are not hazarding lives for glory only. They are advancing aviation by learning things about airplanes.

The biggest thing they have learned is the importance of little things. Ruth Elder would have gotten all the way across if a small feed pipe had not gone bad.

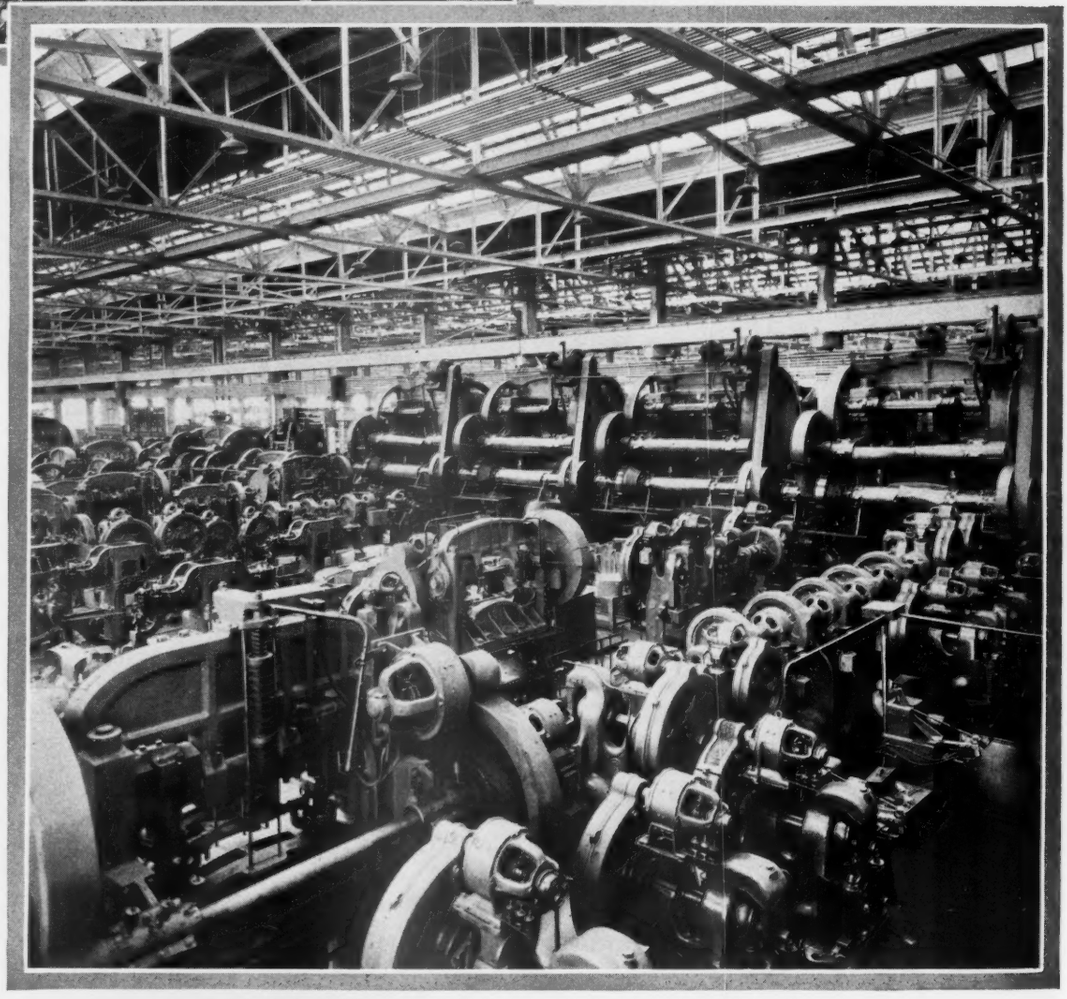
Take a tip from the fliers. Successful plant operation comes from all of the little things being right.

Plant Engineering

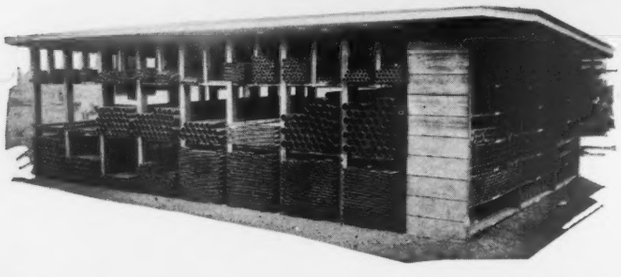


When the patient can't go to the doctor, the doctor must come to the patient. This portable work bench, on wheels, brings maintenance and repair service close to the machine needing it. It saves time.

"Old Sol" will help you cut lighting bills and also help the production men to get out more and better work — if you give him a chance. Systematic skylight and window cleaning is a big factor in keeping plants fit for profits.



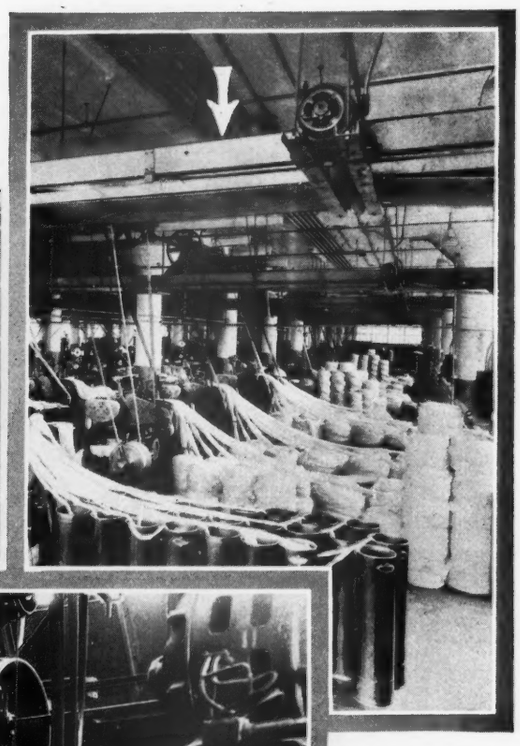
When you see storage facilities like that shown below, you know that the man in charge of materials and supplies is "on to" his job. A sense of order is apparent. This is a "dollars and cents" sense when applied to the services to production.



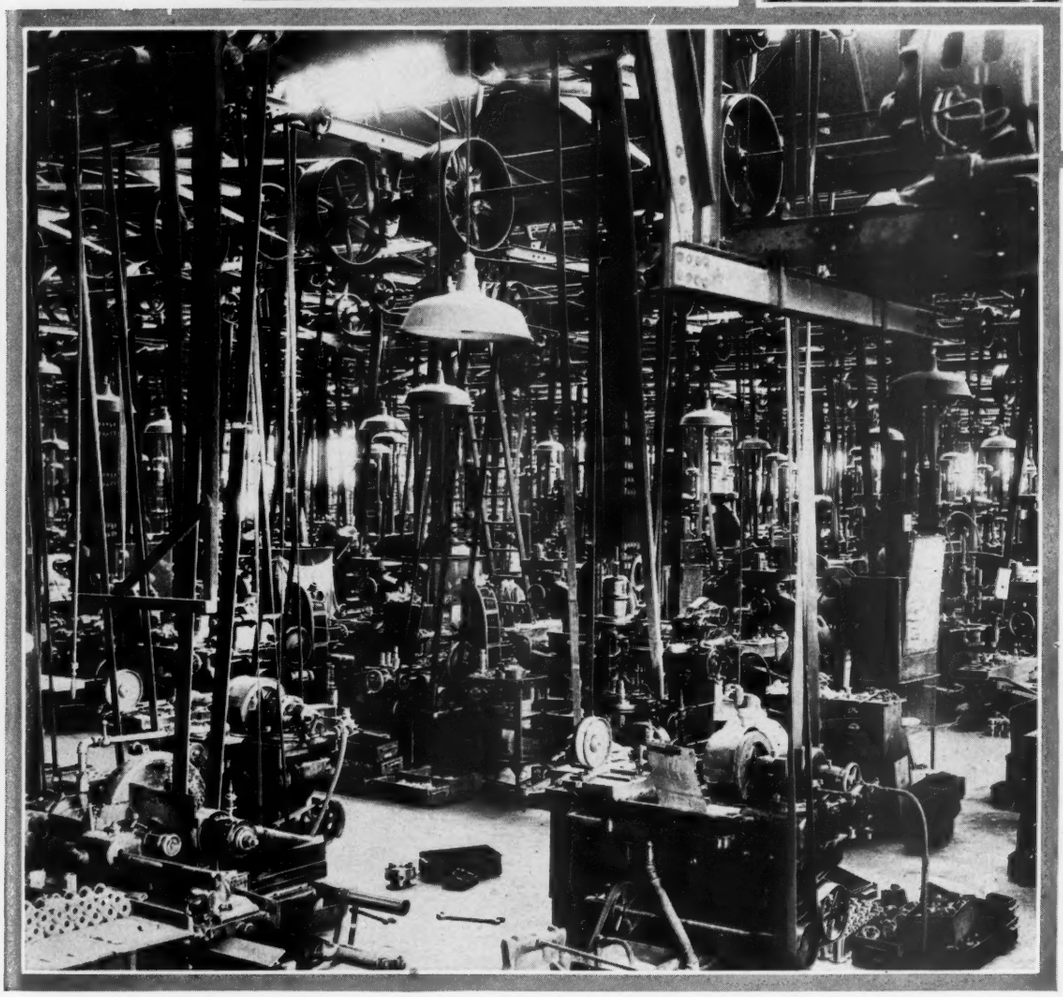
This and the companion picture opposite present in a striking manner, two extremes in power drive practice. Above, we see a one hundred per cent individually motored press and stamping department in the Ford Motor Company's Fordson Works. Note the extremely close machine spacing which is typical of Ford practice.

in Pictures

The plant electrician is often called upon to devise electrical product testing apparatus, as well as to maintain it in working order. This is a corner of the American Rolls-Royce Test Department with meters conveniently arranged.

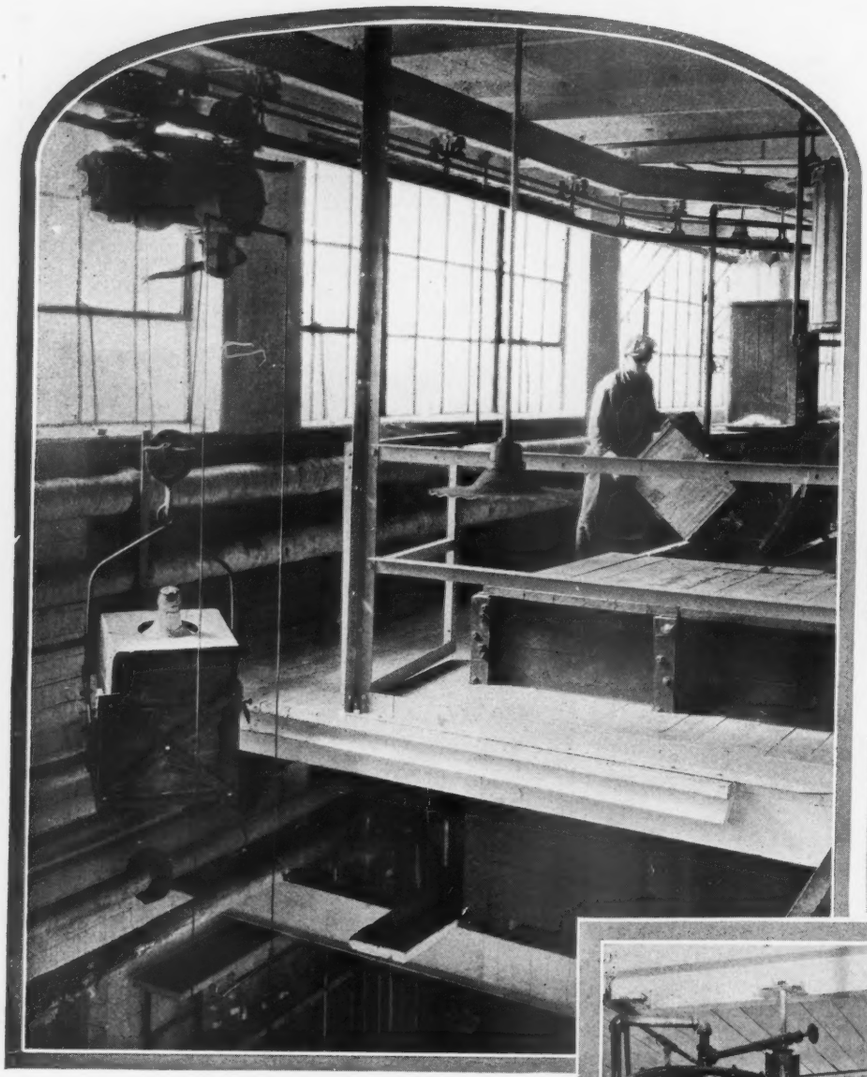


The arrow in the picture above points to a protecting casing which encloses an overhead belt conveyor in the textile works where "Minerva" yarns are made. This enables the belt to run overhead without sag and also prevents spillage of materials.

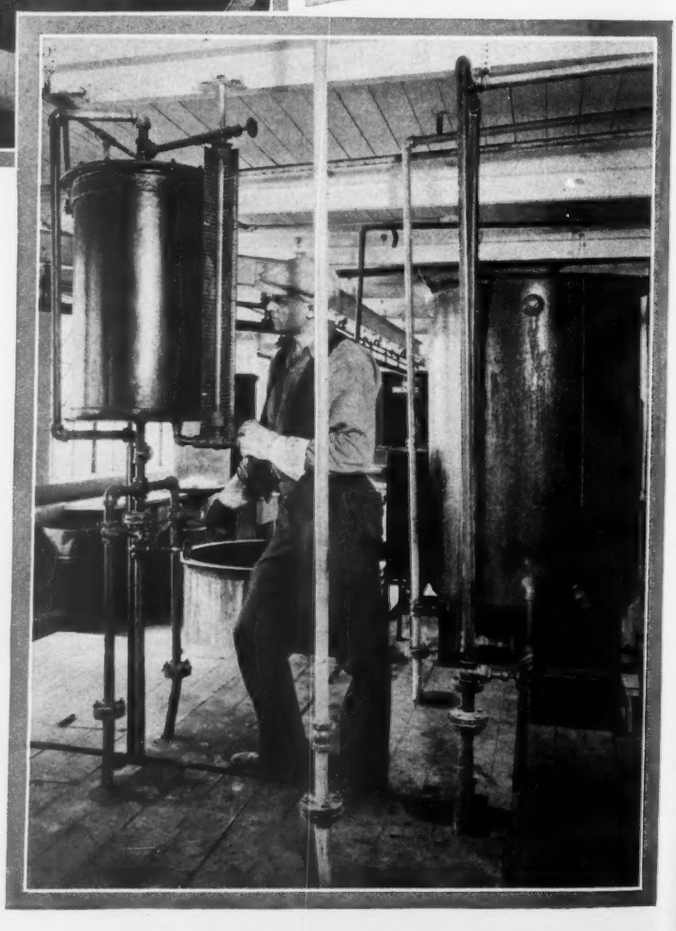


On this side of the page we have an example of what might be called one hundred per cent belt drive. This is a machine department in the American Rolls-Royce plant at Springfield, Mass. Both the belt and individual motor drive plans have their advantages and limitations as well.

Rapid transit for the service to production. Where plants are extensive in area a motor-cycle and side car enables the maintenance men and tools to get quickly to where the plant engineer wants them.



The operator with the bicycle pump starts the acid running from the carboy into the acid-egg on the floor below.



New Methods of Handling Acids Spell Safety

NEW methods of handling carboys of acid have resulted in far greater safety at the plant of the Industrial Fibre Company, of Cleveland. Formerly it was necessary to lift carboys to the second floor where the operator poured the acid into the mixing tanks.

Later, under the direction of Robert W. Sanborn, safety director, what is known as an "acid egg" was installed under the platform. The carboy is emptied by siphoning into this egg or blow-case. The operator starts the acid running by giving a couple of strokes with the bicycle pump and then it empties itself into the egg, which will hold six carboys. Then the valve is closed and locked so that no other workman can tamper with it. The operator then goes to the second floor and by opening a compressed air valve can blow the acid up into the mixing tank.

Reconditioning

Water-Soaked Electrical Equipment

One to three weeks will generally be required for the drying operation, depending on the size, the voltage, the condition, and the method of drying—

says A. C. Roe

WHEN electrical equipment such as generators, motors, transformers, control switchboards, etc., has been submerged, partly or wholly, or exposed to dampness, it should not be used until tested and either found suitable for use, or cleaned and dried, and in some cases dipped and baked or sprayed with a high-grade, air-drying varnish.

The first caution is: *Do not apply a high-voltage test to any piece of electrical apparatus to determine the condition of its insulation to ground.*

The reason for this statement is that usually the equipment has been operating for a year or more and in many cases would not stand the standard A.I.E.E. high-potential ground and between-phases test of twice operating voltage plus 1,000 volts.

All rotating apparatus should withstand a test of 150 per cent of its rated voltage to ground; between phases the test voltage should not in any case be less than 600 volts.

All distribution transformers of 500 to 5,000 volts should stand 7,500 volts to ground and between high-and low-tension windings, and 3,000 volts between the low-voltage winding and ground.

Small units, such as fractional horsepower motors, current and potential transformers, no-voltage release coils, small induction or d.c. motors, etc., should be baked dry in an oven.

Larger units can be dried out on their own foundations, as will be described later.

When oven-drying the smaller apparatus, the important point to keep in mind is that we are attempting to drive moisture or water from the interior of the parts, and that the process must be carried out by long applications of temperature not exceeding 80 to 85 deg. C.

If the temperature is raised too quickly, or is allowed to exceed 85 deg. C., gas or vapor is likely to be generated at a pressure that will puff or puncture the insulation and make a rewind necessary.

Also, when an oven is used to bake water-soaked equipment, good and constant ventilation must be provided to carry off the vapor. What is more important, the heat of the oven must be regulated so that the hottest spot inside any piece of apparatus being baked does not exceed 85 deg. C., for ordinary insulation such as applied to machines up to and including 4,600 volts.

For 6,600-volt windings the hottest accessible part of the winding should not exceed 75 deg. C., total temperature.

For 11,000- and 13,200-volt windings the maximum total temperature should not exceed 65 deg, C. at the hottest accessible part. The reason for reducing the temperature on the higher voltage windings is because thicker insulation is used and there is a greater distance between the inside of the coil and the outside when the temperature is measured by a thermometer.

There is no absolute method of telling when the insulation is bone dry, but measurements of the insulation resistance to ground with a Megger will give an indication of its condition and provide a guide as to whether the winding should be dried internally, or a high-potential test applied.

Remember that the insulation resistance of any piece of apparatus is greater when cold than when hot. Also, the insulation resistance of large armatures will be proportionately lower than small armatures. This is due to the larger area of insulation on the large machine.

During the drying out run readings of the insulation resistance should be taken at regular intervals and plotted as a curve, using time for the horizontal scale and resistance for the vertical scale. The drying out should continue until the resistance has begun to increase and becomes approximately constant. If the insulation contains appreciable moisture the resistance will decrease during the first part of the drying-out process.

The following quotation is of interest, from the A.I.E.E. Standards 7-551.

"Minimum Values — The insulation resistance of the armature of a machine at its operating temperature should not be less than that given by the following formula:

$$\textit{Insulation resistance in megohms} = \frac{\textit{rated voltage}}{\textit{rating in kva.} + 1{,}000}$$

The insulation resistance can be used as a guide for applying a high-potential test, and a safe rule is that the insulation resistance should be approximately 1 megohm for each 10,000 volts applied for testing.

When equipment is too large to be moved, it can be baked by building a box around it and heating by steam coils (steam tight), electric heating units, gas or charcoal in salamanders, providing there is good ventilation in all cases.

If current is available it can be used as follows: Induction motors can be dried out by operating at no-load and low voltage (the current and heating increase as the primary voltage is lowered), or with the motor at a standstill a low voltage can be applied that will allow sufficient current to flow to heat the winding. Alternating or direct current can be used for the stand-still method.

Drying Out D.C. Generators — (1) Drive the generator by its motor or from some external source, and short-circuit the armature beyond the ammeter, using a very weak field excitation. If the generator is shunt wound, low-voltage separate excitation must be employed; if compound wound the armature may be short-circuited through the series field coils.

Direct-current generators are very sensitive when operated as series machines and there is danger of generating an excessive current. Conse-

quently, this method should be used only by experienced operators.

(2) The field coils may be dried by applying from some separate source of excitation approximately two-thirds of the normal direct-current voltage.

There is always danger of serious injury to the windings when drying out with current, as the heat generated in the inner parts is not readily dissipated. Furthermore, coils containing moisture are much more susceptible to injury from overheating than when thoroughly dry. The temperature of all accessible parts should be carefully observed during the drying out process and never allowed to exceed 85 deg. C., total temperature. Several hours or even days may be required for thoroughly drying out large machines.

During the drying-out process the temperature should not be allowed to drop below that of the surrounding air, as moisture then condenses on the coil surfaces and the effect of the previous drying will largely be lost.

In cases where d.c. machines are operating on short-circuit separately excited at a low voltage, excess circulating current can be prevented by shifting the brushes slightly with rotation, or in the case of compound generators, reversing the series field so as to give a bucking action.

Heating windings by current is more effective than any process of heating from the outside, such as enclosing the machine and heating the air by steam coils or a fire.

Synchronous Motors and Generators —These can be dried out by rotating the motor or generator at any convenient speed and short-circuiting the armature beyond the ammeters. The field should be excited so that the desired heating current will flow in the armature winding.

If a low voltage (5 to 15 per cent of normal) can be obtained, the armature winding can be dried out by applying this low voltage to the armature terminals, the rotor remaining stationary. The field winding should be short-circuited and the temperature of the cage-winding on the rotor should be watched. Less than normal current will be necessary on account of the absence of ventilation.

Whenever possible it is highly desirable to dip and bake all stators or armatures and wound rotors in good baking varnish. To obtain the best results the part to be dipped should be heated to approximately 60 deg. C. and allowed to soak in the varnish until all bubbling ceases.

When the apparatus is too large to dip it should be sprayed with a good air-drying varnish, two or more coats being applied, according to the voltage and service.

All exposed surfaces of collector rings, mica V-rings, and riser necks of commutators should be painted with a good insulating compound.

All other exposed parts such as bushings, brush-holders, fiber blocks, etc., should be painted with air-drying varnish suitable for this purpose.

There are three cleaning fluids that can be applied to windings without injurious effect. These are:

(1) Benzine (petroleum naphtha) or gasoline. Both are highly inflammable and their vapors mixed with air are explosive. They should be used only in open places having good ventilation and where fire hazard is small.

(2) Equal parts of carbon tetrachloride and benzine, or 60 per cent carbon tetrachloride and 40 per cent gasoline. Both of these mixtures are non-inflammable, but their vapors mixed with the correct proportions of air are explosive. If ventilation is good they can be used where the fire risk is high.

(3) Carbon tetrachloride is both non-inflammable and non-explosive and can be used under any conditions.

Gasoline and benzine have less corrosive action on insulating varnishes than carbon tetrachloride alone.

The windings should be cleaned as much as possible by scraping or wiping before using any of these liquids.

The rotors of squirrel-cage motors do not have to be bone dry. If the paper cell is not saturated enough to throw off water when in operation they need not be baked, as they will dry out satisfactorily in operation.

All metal parts should be cleaned and painted to prevent corrosion and all bearings opened and drained, the bearing surface cleaned and polished and new oil put in.

Methods of Drying Oil-Insulated Transformers

Treatment of distribution or power transformers presents a slightly different problem, although the remarks pertaining to testing apply. The oil should be tested for water, and if its dielectric strength is low it should be dehydrated by filtering. Where the quantity of oil involved is small it can be discarded and new oil purchased, or it can be collected and filtered using some new oil to service the equipment needed first.

When the oil is removed from the transformer the case and windings should be cleaned and freed of all sludge and scale, before drying out or adding new oil.

There are three methods that may be followed in drying out transformers: (A) by internal heat; (B) by external heat; (C) by internal and external heat.

Drying by Internal Heat—For this method alternating current is required. The transformer should be placed in its case without the oil and the cover left off to allow free circulation of air. The low-tension winding should be short-circuited and sufficient voltage impressed across the high-tension winding to circulate enough current through the coils to maintain the temperature at 75 to 80 deg. C. About one-fifth of normal full-rated current is generally sufficient to do this. The impressed voltage necessary to circulate this current varies within wide limits among different transformers, but will generally be approximately 0.5 per cent to 1½ per cent of normal high-tension voltage at normal frequency.

The end terminals of the winding must be used, not taps, so that current will circulate through the total winding. The amount of current may be controlled by a rheostat in series with the high-voltage winding.

This method of drying out is superficial and slow and should be used only with small transformers, and then only when local conditions prohibit the use of one of the other methods.

Drying Out by External Heat — The transformer should be placed in a wooden box with holes in the top and near the bottom to allow air circulation. The clearance between the sides of the transformer and the box should be small so that most of the heated air will pass up through the ventilating ducts among the coils and not around the sides. The heat should be applied at the bottom of the box.

The best way to obtain the heat is from grid resistors, using either alternating or direct current. The temperature limits are the same as given above. The transformer must be carefully protected against direct radiation from the heaters. It is advisable to line the lower part of the wooden box with asbestos.

Instead of placing the heater inside the box containing the transformer, it may be placed outside and the heat carried into the bottom of the box through a suitable pipe. Where this plan is followed, the heat may be generated by the direct combustion of gas, coal or wood, provided that none of the products of combustion be allowed to enter the box containing the transformer. Heating by combustion is not advocated except when electric current is not available.

This method, while effective, requires a much longer time than the following method, which is generally recommended.

Drying by Internal and External Heat

The transformer should be placed in a box and external heat applied while current is circulated through the windings. The current should, of course, be considerably less than when no external heat is applied.

This method is used occasionally where direct current only is available, a certain amount of current being passed through the high-voltage winding only, as the cross-sectional area of the low-voltage conductor is generally too large for it to be heated with an economical amount of direct current. The use of direct current for drying out is not recommended except where alternating current cannot be obtained.

On the whole this method is quicker than either of the others and has the great advantage that the insulation is heated much more uniformly.

If the initial insulation resistance is measured at ordinary temperatures it may be high, although the insulation is not dry, but as the transformer is heated up it will drop rapidly.

As the drying proceeds at a constant temperature, the insulation resistance

will generally increase gradually until toward the end of the drying period when the increase will become more rapid. Sometimes the resistance will rise and fall through a short range one or more times before reaching a steady high point. This is caused by moisture in the interior parts of the insulation working its way out through the outer portions which were dried at first. As the temperature varies, the insulation resistance also varies greatly; therefore the temperature should be kept nearly constant and the resistance measurements should all be taken at as nearly the same temperature as possible. Measurements should be taken every few hours during the drying period.

A curve of the insulation resistance measurements should be plotted with time as abscissas and resistance as ordinates. By observation the knee of the curve (i.e., the point where the insulation resistance begins to increase more rapidly) can be determined. The total drying period should be about 115 per cent of the time preceding the passing of the knee of the curve.

As the drying temperature approaches the point where fibrous materials deteriorate great care must be taken to see that there are no points where the temperature exceeds 85 deg. C. Several thermometers should be used. They should be placed well in among the coils near the top and screened from air currents. Ventilating ducts offer particularly good places in which to place some of the thermometers. As the temperature rises rapidly at first, the thermometers must be read at intervals of about ½ hour. In order to keep the transformer at a constant temperature for insulation resistance measurements, one thermometer should be placed where it can be read without removing or changing position. The other thermometers should be shifted about until the hottest points are found, and should remain at these points throughout the drying period. Wherever possible the temperature should be checked by the increase-of-resistance method.

When a transformer is being dried out remember that it is soaked with oil and in an inflammable condition. While hot it may be ignited very easily by an arc or flame of any kind. It is well to have a chemical extinguisher or a supply of sand at hand for use in case of fire.

It is not safe to attempt to dry out transformers without giving them constant attention.

Exposed paper or thin fibre parts, etc., will, if subjected to any protracted immersion in water, swell up and become so distorted that they are useless. These parts should be replaced with new ones, for the best results.

Careful inspection should also be made of any untreated wood details, as these are likely to swell or warp, depending on the grade and hardness of wood used and its condition when new.

Careful consideration must be given to the possible presence of water or moisture between the laminations or in the ventilating ducts and the baking or drying out time governed accordingly.

Engineering Committee Adopts Simplified Wrench Stamping

BECAUSE of the recent addition of the new American Standard of bolt and nut sizes necessitating additional combinations of wrench openings, it is no longer feasible to stamp wrenches with all of the various standard bolt and nut sizes, and the symbols heretofore employed.

The principal members of the drop-forged wrench industry have, therefore, seized the present opportune occasion to simplify their stamping practice by stamping wrenches with only the size of opening. Except for disposal of stock on hand, all wrenches shipped hereafter will carry this simplified stamping.

To avoid unnecessary confusion and to educate both mechanics and distributors to the new practice, J. H. Williams & Co., Buffalo, N. Y., has prepared the accompanying table of standard bolt, nut and cap screw sizes served by each wrench opening.

Previously, the custom was to stamp the heads of drop-forged wrenches having fixed openings with the bolt or cap screw size each opening would accommodate. For instance, a wrench with an opening of $\frac{7}{8}$ in. would be stamped to indicate that the opening would fit U. S. Standard nuts for $\frac{1}{2}$-in. bolts, hex cap screws of $\frac{5}{8}$-in. diameter screw, and S. A. E. Standard cap screws of $\frac{9}{16}$-in. diameter screw and nuts for same.

The new American Standard bolt and nut sizes recently adopted would add other markings to the list already carried by the wrench, consequently the American Engineering Standards Committee specified that, wrenches shall be marked with the width across flats of the nut, etc., they are designed to fit.

COMPARATIVE WRENCH SIZES FOR STANDARD BOLT, NUT AND SCREW SIZES

*Wrench Openings as Stamped	U. S. Standard		S. A. E. Std. for S. A. E. Std. Nuts and Cap Screws: Size Bolts	American Standard	
	For U. S. Std. Nuts; Size Bolts	For U. S. Hex. Head Cap Screws Diameter Screws		For American Std. Nuts; Size Bolts	For American Std. Hex. Head Cap Screw Dia. Screws
5/16	1/8	1/8			
3/8	....	5/16	....	....	....
13/32	5/16	....	....	....	....
7/16	....	1/4	1/4	1/4	1/4
1/2	1/4	5/16	5/16	....	5/16
9/16	....	3/8	3/8	5/16	3/8
19/32	5/16	....	....	....	....
5/8	....	7/16	7/16	3/8	7/16
11/16	3/8	....	....	....	....
3/4	....	1/2	1/2	7/16	1/2
25/32	7/16	....	....	....	....
13/16	....	9/16	....	1/2	9/16
7/8	1/2	5/8	9/16	9/16	5/8
15/16	....	....	....	5/8	....
31/32	9/16	....	....	....	....
1	....	3/4	11/16	....	3/4
1 1/16	5/8	....	3/4	....	....
1 1/16	....	7/8	....	3/4	7/8
1 1/4	3/4	1	7/8	....	1
1 5/16	....	....	....	7/8	....
1 3/8	....	1 1/8	1	....	....
1 7/16	7/8	....	....	1	1 1/8
1 1/2	1	1 1/4	1 1/8	....	....
1 5/8	....	1 3/8	....	1 1/8	1 1/4
1 11/16	1 1/8	....	1 1/4	....	....
1 13/16	....	....	....	1 1/4	....
1 7/8	1 1/4	....	1 3/8	....	....
2	....	....	1 1/2	1 3/8	....
2 1/16	1 3/8	....	....	....	....
2 1/4	....	....	....	1 1/2	....
2 3/8	1 1/2	....	....	....	....
2 7/16	1 5/8	....	....	....	....
2 5/8	....	....	....	1 3/4	....
2 3/4	1 3/4	....	....	....	....
2 15/16	1 7/8	....	....	....	....
3	....	....	....	2	....
3 1/16	2	....	....	....	....
3 3/8	....	....	....	2 1/4	....
3 1/2	2 1/4	....	....	....	....
3 3/4	....	....	....	2 1/2	....
3 7/8	2 1/2	....	....	....	....
4 1/8	....	....	....	2 3/4	....
4 1/4	2 3/4	....	....	....	....
4 1/2	....	....	....	3	....
4 5/8	3	....	....	....	....
5	3 1/4	....	....	....	....
5 3/8	3 1/2	....	....	....	....
5 3/4	3 3/4	....	....	....	....
6 1/8	4	....	....	....	....
6 7/8	4 1/2	....	....	....	....
7 5/8	5	....	....	....	....

*Proper clearance is provided by the manufacturer.

What a Flood Means to the Plant Engineer

(Continued from page 554)

height varying from 14 to 20 in. on the ground floors. The tunnels were, of course, completely filled, thus cutting off all light, heat, and power. Most of the power is generated locally. The boilers are oil-fired, but the boiler room was flooded and the oil burners entirely submerged.

A connection was made with an emergency power line from the local utility, so that lights could be obtained in the power house. However, the big problem was to get the water out of the tunnels. No motor-driven pumps were available, but a 1,500-g.p.m. turbine-driven, centrifugal pump is used for the condensers. It was eventually decided to use this pump to empty the tunnels. The question of steam supply was settled by driving the yard switch engine alongside the power house and running a steam line from the boiler to pump turbine. An 8-in. suction line from the pump was put into one of the tunnels, and in a comparatively few hours this tunnel was empty. The discharge was carried through the lines leading to the cooling pond and emptied into a sewer in the street.

The three tunnels are separated by low walls; so it was necessary to pump each one out in turn.

Drying the Conduit Lines

By the time the tunnels were empty the water had receded so that the boilers could again be fired. The next step was to dry out the conduit lines in the tunnels. To remove the feeders, which range from 4/0 to 300,000 circ.mil in size, would have been a difficult task; so it was decided to try other means.

Previous experience had shown that after submersion, trouble is most likely to occur at splices. Accordingly these were untaped. Then compressed air lines were run into one end of the conduits and sealed in as well as could be. The compressed air effectively removed the water and much of the mud and sediment. The air was kept on for about three days and the tunnels heated to a temperature of between 80 and 85 deg. F. Provisions were made to secure as much ventilation as possible. Megger readings were taken on the lines at fairly frequent intervals and when these reached what was considered to be a satisfactory value, the splices were retaped and power turned on. After a week of operation no trouble had been experienced with any line.

A total of 45 squirrel-cage motors and one slip-ring motor were submerged for two or three days. These motors range in size from 3 to 20 hp. They were taken apart as quickly as possible, cleaned and dried out in an oven at 150 deg. F. for two to four days. At the end of this period they were given a Megger test. Motors that gave a reading of 40,000 ohms or above were put back in service, although several soon failed. A number of other motors either gave a low Megger reading or failed during the subsequent running test at line voltage; so a total of 16 motors were sent to a local repair shop for rewinding.

Directions for the treatment of electrical equipment that has been submerged are given on page 585.

Under emergency conditions that affected a wide area and in which the physical strength and loyalty of plant men were severely tested through long days and nights of constant struggle and danger, many heroic deeds were performed. One of the most dramatic battles was waged at the United Electric Light Co., Springfield, Mass., in its struggle to maintain power and lighting service in the stricken city.

The older portion of the station is built close to the river's edge and when the water rose nearly 24 ft. above normal level a critical situation ensued. Construction work was in progress and when the flood came, a large hole that had been cut in the wall for the installation of new cables was hastily plugged and further protected by a rough cofferdam. Within a few hours the old walls were submerged to a depth of about 15 ft. by a raging torrent that swirled around them with almost irresistible force.

The basement of the old building is a veritable maze of vaults and passageways. Here a force of men varying from 40 to 60 in number staged a grim battle against the forces of nature, and eventually won out. Working 15 ft. below the level of the river and protected only by old masonry walls of unknown but doubtful strength, these men were in imminent danger of sudden death at any moment. If the old walls had failed there would have been little or no chance for anyone to escape. Fully realizing the situation, these men, nevertheless, worked for three days and nights strengthening the walls with thousands of sandbags, plugging leaks where the water rushed in, and hastily putting every available pump to work in a desperate effort to keep the water from rising high enough to put the station out of commission.

In the end, high courage and utter disregard of danger and fatigue saved the day, and service was maintained without interruption.

Less dramatic but no less strenuous efforts were made in hundreds of plants to save equipment and raw materials or finished products from damage, when basements and even ground floors were flooded in some of the higher sections of the city.

In a paper mill more than a million pounds of stock was moved within a few hours from the basement to a safe storage place in another plant. Gas and electric trucks, hand trucks, wheelbarrows—every available means of transporting material were employed to move the stock, and it was all taken out in time to avoid damage.

How Other Plants Managed

At North Adams, Mass., more than a hundred feet of one wall of a large textile mill on the banks of the Hoosic River collapsed when the swollen river undermined the foundation. This mill is rushed with orders, so a temporary wooden wall was erected on each floor. Equipment that was flooded was hastily cleaned out or replaced, and production went on with little interruption.

In a large worsted mill part of the wall of a small brick structure housing the fire pumps was washed away, allowing the flood waters to flow through the storerooms in the basement of one of the main buildings. When the water went down more than a foot of mud, bricks, and rubbish of every description was left behind. Part of this has been removed, but weeks will be required to take all of it away.

Similar stories could be told about hundreds of plants in the flooded area. When disaster came the plant forces met it coolly and bravely, doing everything that was humanly possible to prevent or minimize damage to equipment and material. In many cases, they succeeded wonderfully well. When the odds were against them and their plants were engulfed, these men set to work with undaunted courage and clear heads to repair the damage and get the wheels of industry turning again just as quickly as possible.

Limitations of

SILENT CHAIN DRIVES

that affect the design and service for many transmission purposes

[The application of silent chain drive has solved many transmission problems, but it has not been the solution of all transmission trouble.]

By A. B. Wray
Chief Engineer, Morse Chain Co.
Ithaca, N. Y.

IT IS DIFFICULT for one who has been associated with the development of silent chain drive for nearly twenty-five years to realize that silent chain driving is still in its infancy. As compared with belting, gearing, and perhaps other forms of power transmission equipment, it is a veritable youngster.

When the silent chain drive was first introduced, it was considered chiefly as a possible drive where belting or gearing seemed impractical. Today its application is extensive and it has solved many transmission problems.

The commercial use of the silent chain has extended over a period of some thirty years. In the early days, the design of each of these drives was a strictly engineering proposition based on the special requirements. The art of chain driving as we have it today has been built up from the knowledge obtained by designing drives for definite requirements as to horsepower, speeds, center distances, service, etc.

The average engineer feels perfectly able to select what he considers a proper belt drive or gear drive for his particular service. These methods of power transmission have been used so many years that information as to theory of operation and capacity has been well developed and very complete engineering data are available in every handbook and treatise on power transmission.

The silent chain manufacturer has now come to the point when he too must disseminate data so that engineers can properly select their own drive. Also, he must try to put his engineering data in such form that they will be easily understood and as readily used as the data on gearing and belting. First, however, must come a more adequate understanding by prospective users of the general limits of application.

The manufacturers of silent chain drives do not claim that their drives should be used for all transmission purposes, or that they are the solution of all transmission troubles.

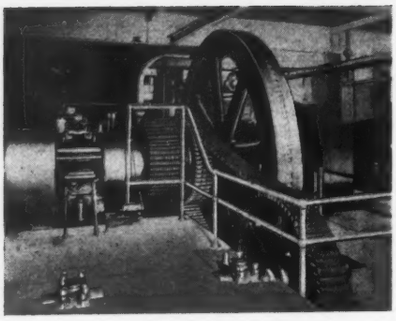
There are limitations as to design and service and a general knowledge of these will be helpful to all concerned.

Horsepower — The largest power transmitted by silent chain drive in a single strand of chain is 1,000 horsepower, but by the use of multiple strands a 5,000-hp. generator is being driven from two water turbines. The smallest drive is transmitting small fractions of a horsepower, a complete drive weighing only a few ounces.

Speeds—The smaller pitch chains will transmit small horsepowers at speeds of over 6,000 r.p.m. Some of the large pitches are not capable of running over 250 r.p.m. Each pitch (the chain manufacturer figures his chains and sprocket by circular pitch), is suitable for certain speeds. The drive will be noisy if running above its rated speed. It is customary to use the largest pitch the speed will allow, as this keeps the cost of the drive to a minimum.

Ratios—For ordinary service best results will be obtained by keeping the ratio less than 8 to 1; however, there are many cases where large ratios are being successfully handled. It is often cheaper to go to a double-reduction drive than to handle an extremely large ratio in a single drive. An excessively large sprocket is unwieldy. A more compact installation is obtained with a double reduction. The drive is equally satisfactory with a speed-up or reduction. On a speed-up drive, it is customary not to try to handle as large speed ratios.

Center Distances — Long centers should be avoided with silent chain drives. In fact, with excessive long centers the price of the drive is often prohibitive. The advantage of this drive is that it enables two shafts to be placed on a minimum center distance, thus making a compact, neat installation. The minimum center distance for a certain pitch is a function of the speed ratio. It is best practice to have the opening angle made by the two strands of chain less than 35 deg., unless the tight strand of chain is on the bottom; then it is possible to increase the open angle as each sprocket is wrapped more than half way by the chain. Sometimes it is preferable on an extremely short-center drive to run the tight strand of chain on the top. On a large ratio the tight strand chain should usually be run on the bottom.



WHERE THE CENTER DISTANCE WAS TOO GREAT FOR A GEAR DRIVE

These silent chains transmit 2,000 hp. in driving 22 rubber mills and 6 calenders. End play is provided for, by holding the sprocket in alignment and allowing the shaft with a feather key to slide through the hub.

Sprocket Teeth—It is seldom advisable to use less than 13 teeth in a pinion. On rare occasions sprockets with as few as 11 teeth have been used. It is seldom advisable to use sprockets with more than 135 teeth, although there are many cases where considerably larger sprockets have been used. The chain speed usually determines the size of the sprocket. It is perfectly possible to run the chain speed up to 1,400 ft. a minute, and a chain speed of 1,600 or 1,700 ft. a minute is often good practice.

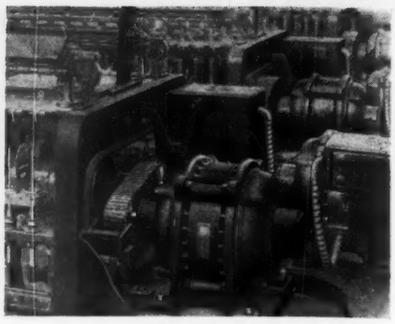
Chain Width—Roughly speaking the maximum chain width is about twelve times the pitch; however, by the use of a multiple-strand drive very much larger powers can be transmitted. The 5,000-hp. drive referred to above was handled by eight strands of chain, each strand 2 in. pitch, 20 in. wide. Two-strand drives are very common, and occasionally drives with more than two strands have been installed and successfully operated.

Noise—If a chain of a certain pitch is over-speeded it becomes more noisy. By the same token, if a pitch is under-speeded, it becomes more quiet. There are certain cases where noise is objectionable in which a smaller pitch than is indicated by the rotative speed should be used.

There are certain classes of service that the silent chain manufacturer investigates very carefully before applying the drive. Among them are compressors and engines. Are the fly wheels on these machines heavy enough to give uniform rotation during a single revolution? If not, the chain will whip and the whip may be disastrous. Of course, on multiple cylinder machines there is less tendency for the chain to whip and the balance wheels provided on the machines are usually heavy enough to give very uniform rotation. The single cylinder machines are the ones with which to be particularly careful. Other reciprocating machines should be examined critically, such as metal planers, slotters, flat-bed printing presses, etc. The silent chain manufacturer does, however, make a spring sprocket which can be used to advantage on this type of machinery.

Excessive end play in shafts has to be provided for. When the movement of the shafts is considerable, it is usually possible to hold the sprocket stationary and allow the shaft to slide through with a feather key.

A number of years ago a certain rubber mill was making plans for enlarging the plant. It was desired to install a 2,000-hp. engine midway between two line shafts, which drove 22 rubber mills and 6 calenders. The center distance was much too short for a belt drive. To use rope drive would have necessitated remodeling the upper stories of the mill to provide a tightener carriage. The center distances were too long for gear drives. Had gears been used it would have necessitated a train of three gears. These would prove troublesome and noisy. They knew they could obtain an efficiency of 98½ per cent with silent chain drives. The installation was made some 18 years ago and is still running successfully.



OIL WAS A DETERRENT TO THESE DRIVES WHEN BELTS WERE USED

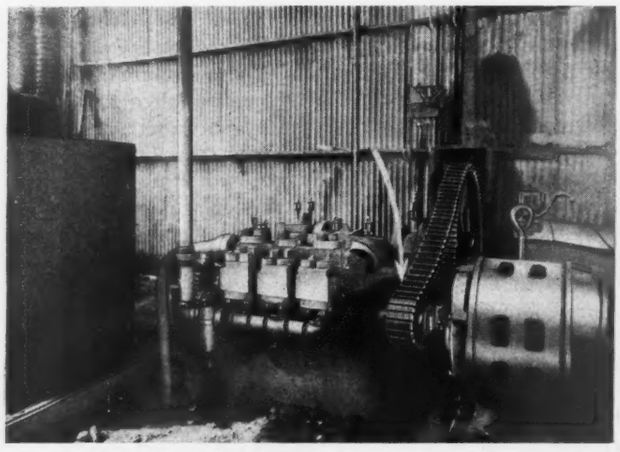
Alteration in the product is prevented by the elimination of slippage.

When the magnetic clutch with solenoid brake first came on the market, a question arose in the minds of some engineers as to whether the silent chain could stand the strain which would come from the sudden stopping of the machinery, through throwing the clutch and immediately stopping the driver shaft. A good many of these magnetic clutches have been installed and the difficulties that these engineers feared have never been realized.

Many engineers prefer chain drives to gears for this service. If for any reason lubrication of the gears is

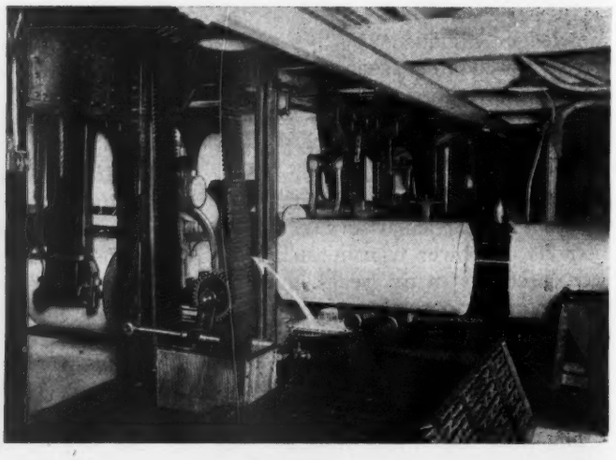
FIVE YEARS SERVICE WITHOUT AN HOUR'S DELAY

The Penn Forge Company eliminated press production delays due to gear breakage with this silent chain installation on its high-pressure pump.



WHERE EDITIONS MUST BE RUN OUT ON TIME

A vertical silent chain having an adjustable idler drives the presses in a mid-western newspaper plant. Heretofore, vertical drives were to be avoided.



neglected for a short time, they are ruined and it entails having duplicates on hand, and the cost of taking out the old and installing new ones. With a chain this would not be likely because a chain can go days without lubrication attention and without serious damage. If the chain was spoiled the sprockets themselves would be uninjured. In fact, it is impossible to break the chain gears, on account of the number of teeth engaged. The chain might indeed break, but that would occur only if not in alignment, or if bought too light for the work. If a chain is to be removed for wear or for any other reason, it is only a matter of a few hours to put one on and the cost of a reserve chain is very small as compared to a set of gears.

Installation Economies

Some think that chain drives take up a good deal of room but it is not so. Take for example a 250-hp. motor, the center distance can probably be between 5 and 6 ft. The motor can be set on the floor level driving down to the line shaft at an angle. This reduces the apparent amount of room required and saves the deep excavation required by gears as practiced by some.

The silent chain manufacturer has always considered a vertical drive as one to be avoided. If a vertical drive is necessary some method must be provided either to adjust the center distance or take care of the slack in the chain, which develops from wear. This can often be accomplished with an idler. If an idler cannot be conveniently installed, the chain can be shortened as wear develops, ordinarily two links at a time, but with the use of a hunting link, one link at a time. A very interesting installation is on large newspaper presses. These presses came equipped with vertical shaft and gear drive, but for eighteen months the excessive friction made it a constant uphill fight to keep the presses running and the editions put out on time. Maintenance costs were very high.

A 100-hp., chain drive was installed connecting the driver shaft running 325 r.p.m. to the driven shaft running 300 r.p.m. on 128-in. centers; these shafts were directly, one above the other. The adoption of this chain drive eliminated three sets of gears in each drive or a total of six gears. In spite of the terrific speed at which the chain must work, the operation was much smoother and practically noiseless. The chain used less than 5 per cent as much oil and grease for lubrication, eliminated one man and materially reduced current consumption.

Roller Bearings on Conveyors

(Continued from page 577)

been developed, two typical examples being shown in Figs. 10 and 11. The wheels are usually of the dead-axle type. The cups are usually given a press fit in the wheel hub, and the cones a metal to metal fit on the axle. One very simple method is shown in Fig. 10, in which the cups are installed in the usual manner, and the cones are properly set up on a sleeve. The whole comprises a unit assembly of wheel and bearings. The unit is properly located by the conveyor links. Both the outer and inner closures are made up of labyrinth washers. The assembly shown in Fig. 11, is different in that it is somewhat more complicated; (cones are fitted directly on the shaft) and in that it does not permit of unit assembly such as that illustrated in the preceding figure.

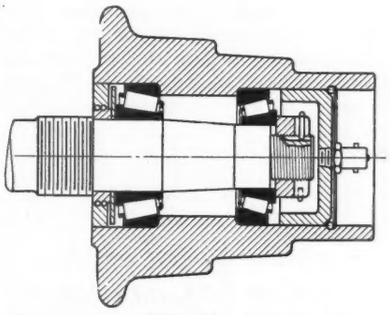


FIG. 12—TYPICAL BEARING MOUNTING FOR PALLET WHEELS OF SLAG CONVEYORS

The bearing cups on both sides are pressed against shoulders machined in the wheel hub. The cones are given a light fit on the shaft.

It will be noted in both cases that the entire space between the bearings is available as a reservoir for lubricant, which is inserted through a hole bored in the hub of the wheel. Because of this arrangement a supply of lubricant sufficient to last for some time without necessity of renewal is permanently insured.

Another type of installation which somewhat resembles that made to the conveyor wheels just described, but which is interesting because of the exceptionally severe service requirements are the pallet wheels of slag conveyors used in steel mills. In this instance not only are the bearings subjected to heavy thrust and radial loads, but to relatively high temperatures as well. The latter condition naturally tends to make proper lubrication of the bearings rather more of a problem than is usually the case. A typical example of such an installation is shown in Fig. 12. The bearing cups on both sides are pressed against shoulders machined in the wheel hub, and the cones are given a light fit on the shaft. The closures are of very simple, but of very effective construction, and are so designed as to completely prevent not only the leakage of the lubricant, but the entrance of foreign matter under all conditions of heat. The lubricant is supplied through counter-bored holes in the shaft, and the space between the bearings is utilized as a reservoir. The whole assembly is characterized by its strength and simplicity.

Reinforcing Welded Joints to Increase Strength

UNLESS the work has been very carefully done, a weld in heavily stressed parts is likely to be of less strength than was the original material. To compensate for this diminution in strength of the broken part, in addition to amply filling around the joint, some method of reinforcing the welded joint is often adopted.

To reinforce a break in a solid bar, a sleeve may be placed over the break and welded at both ends. This method is employed where the joint in the rod is stressed by either a pull or by a bending force.

An inner sleeve may be used in tubing, to reinforce a welded joint. This method of repair will suffice where the joint is subjected to either a bending or a tensile stress.

Plate welds which are as strong as the plate are difficult to make. The best way of making a very strong joint is to use butt straps. Holes are punched in the strap, and the welding is done both at the break and at the holes in the reinforcing straps. When properly made, such a joint is very satisfactory and makes a continuous weld across the plate unnecessary.

These methods of reinforcing welds not only represent years of study by a large plant specializing in shop and ship repairs, but they have proved their effectiveness, for some of the joints have been tested under actual working conditions in the same plant where they were made.

GEORGI: A. LUERS.
Washington, D. C.

QUESTIONS
Asked and Answered By Readers

HERE IS A PLACE *where you can get some inside information when you get stuck. The only restriction is that you do a good turn to the other fellow when he asks a question that you can answer from your experience.*

Practical Pete

Location of Elevator Motors

Due to alterations in one of our four story buildings, the location of the two present elevators is to be changed. But before the new electric elevators are installed, we wish to have readers advise us of the advantages of elevators equipped with overhead motors as compared with motors located at the foot of elevator shafts.

Portland, Ore. S. B. V.

Resistance of Coils Delta Connected

We are experiencing difficulty with a piece of equipment that has three coils connected in delta. After a study of the operation of the equipment, it seems as if the resistance of the coil in one phase must be different than the others. These three coils are sealed in such a way that only the leads, which are tapped to the interconnecting points of the coils, are available. It would, therefore, be to our advantage in several ways if we knew how to determine the resistance of each coil from data obtained by measuring the resistance between the three main phase connections.

Los Angeles, Cal. R. W. D.

Heating of Armature After Rewinding

After rewinding a d.c. lap-wound armature having 24 slots, 2 coils, and 40 turns of No. 26 wire, the 48 segments became very hot after running only a very short time, although the number of wires and number of turns are the same as before. The coils in the slots are wound with a pitch of 1-and-12, and the connection leads with a pitch of 1-and-12. The brushes are located in the center with the poles. The first coil is wound clockwise on one side of the shaft, and the second coil is wound on the other side of the shaft, all leads being brought forward in the same direction. It seems that if the first and second coils are not spread with the shaft between them, there is no trouble; but with this style of armature a better job can be made by having them split. Would I have to change the lead of the second coil, the reverse to No. 1 coil, by taking the leads of the second coil back 12 slots instead of forward, as in coil No. 1?

Toronto, Canada. F. A. E.

QUESTIONS
Who Can Answer These?

Can the Speed of this Motor be Changed Without Rewinding?

We have a Type ITC, Form M, 720-r.p.m., three-phase, 10-pole, 60-cycle, G.E., slipring motor with approximately 120 rotor slots and 90 stator slots, the intermittant duty horse power being 22. The rotor in this case is bar wound with end connections. As we wish to increase the speed of this motor without rewinding it, will readers kindly tell me how to reconnect the motor?

Seattle, Wash. W. M. P.

How Many Machines in a Group?

We are planning on moving about 100 machines, all practically alike, into an extension to the plant. At present these are driven as a single group by a 100-hp. motor belted to a main lineshaft extending down the center of the plant. The individual countershafts are either belted to this mainshaft or to one of the two parallel shafts which also extend the full length of the building and are belted, one on each side of the mainshaft. We believe that it would be advantageous to break up this drive into smaller groups. Our opinions on size of groups vary from 10 to 25 machines per group. It is agreed that the motor used should rate at 1 hp. per machine. Would other readers please give us their opinions or experience on relative cost and advantages of using groups of these various sizes.

Philadelphia, Pa. B. W.

Selection of Pulleys and Belts

When selecting pulleys and belts, should serious consideration be given to the coefficient of friction between a particular type of pulley and a certain kind of belt? Also, when operating belts at a speed of 6,000 ft. per minute, will a special treatment or construction of the face of the pulley result in a greater coefficient of friction?

Lowell, Mass. K. M. S.

Cleaning Switchboards

Our switchboards are operated continuously day and night, with the result that they must be cleaned and cared for while in operation. As we have experienced some difficulty in caring for them will readers tell me how they clean boards operating under conditions similar to ours? Also, should Duco or some other paint or preparation be applied, and, if so, how?

Utica, N. Y. L. W. J.

Compound Winding of D.C. Generators

We are desirous of learning the number of turns needed for a flat compound winding of a 125-volt d.c. generator and also a 250-volt generator. So will readers kindly furnish me with a formula, which is suitable for ordinary repair shop practice, for determining the desired number of turns.

Chicago, Ill. W. H. K.

ANSWERS *Received to Questions Asked*

Maximum Economical Size of Motor for Group Drives

We have a number of group drives operating screw machines, lathes, and so on, the driving motors ranging between 20 and 40 hp. Installation of new machines will make it necessary to replace two 40-hp. induction motors with larger ones, or to split these two drives into smaller groups. I understand that some plants will not use a motor in excess of 35-hp. rating on a group drive, the group being split up when the power required exceeds this figure. I wish that some readers would let me know what their policy is on this point, and tell me how they determine the maximum economical size of motors for group drives. That is, when should a group drive be split up instead of installing a larger motor to take care of increased power demand?
Moline, Ill. W. B.

IN ANSWER to the question by W. B., the problem of limiting the size of motors used for group drives and the application of motors to individual machines must be considered in a manner similar to many other engineering problems—namely, by determining which method is the most economical financially.

To properly study the desirabilities of certain motor applications, a number of factors must be considered, the value or importance of each depending upon the existing conditions or those that are likely to exist in the future. Among the important factors to be considered are the following:

1. Investment in building material necessary to accommodate the weight of the line shafts, hangers, pulleys, and the like.

2. Overhead shafting, belts, and pulleys will require more head room than unit drives and may interfere with the diffusion of natural light. Also, there may be a greater risk of physical injury with this type of drive due to mechanical breakage or to belting.

3. Cost of maintenance including lubrication and repairs.

4. Speed regulation and loss of production in the event of a burnout, breaking of belts, or other accidents that may stop an entire group of machines for long periods and involve extensive repairs.

Speed regulation has an important influence on the quality of the product and must be given careful consideration. It is usually wise to consider overtime conditions in which only a small part of a group may be necessary.

Constant or fluctuating loads must receive due consideration or further losses that are hard to calculate may be encountered. For intermittent loads or loads requiring a variable speed, individual drives are the proper ones to employ. In the case of W. B.'s drive, which I judge is in a machine shop, a group drive is not efficient. However, the greater installation cost of individual drives in many cases may not warrant the required investment, all factors considered, from a financial standpoint.

So, if W. B. cannot change to individual drives due to financial limitations or for other reasons, he should split the drive into smaller groups rather than replace the present drives with larger motors. B. W. SCOTT.

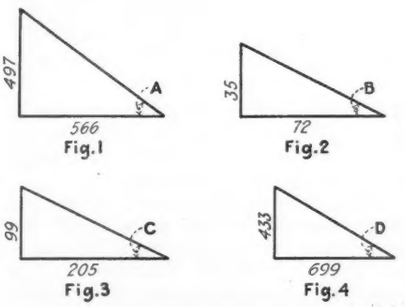
Assistant to Electrical Engineer,
American Woolen Co.,
Andover, Mass.

Loading Synchronous Motor to Improve Plant Power Factor

The total load on our plant is 566 kw., at 75 per cent lagging power factor when a three-phase, 440-volt, synchronous motor is pulling 105 amp., from the line, with the excitation adjusted for 90 per cent leading power factor. Will some reader tell me what the plant power factor will be if the synchronous motor load is increased to 300 amp., and the excitation adjusted for 90 per cent leading power factor at this load?
Cleveland, Ohio. B. E.

IN ANSWER to the question by B. E., the power factor of the system, after the load on the synchronous motor has been increased so that it uses 300 amp., may be determined as follows:

Fig. 1 represents the components of the total load when the synchronous motor is drawing 105 amp. Since the power factor of the line is 75 per cent, angle $A = 41$ deg. 20 min. The total reactive component is, therefore, $566 \times \tan 41$ deg. 20 min. $= 497$.



THE PRINCIPAL STEPS USED IN DETERMINING THE NEW POWER FACTOR OF THE SYSTEM

The load taken by the three-phase synchronous motor is $105 \times 440 \times \sqrt{3} = 80$ kva. At 90 per cent power factor, angle B in Fig. 2 $= 25$ deg. 50 min. The active component $= 80 \times \cos B = 72$ kw., and the reactive component $= 80 \times \sin B = 35$ kva.

The difference betwen the components of the total load and of the synchronous motor load must be the components of the remaining load (lagging). Without the synchronous motor the active component $= 566 - 72 = 494$ kw., the reactive component $= 497 + 35 = 532$ kva. and the power factor is 68 per cent.

If the synchronous motor is to draw 300 amp., 440 volts, at 90 per cent power factor leading, the load taken by the motor will be $300 \times 400 \times \sqrt{3} = 228$ kva. In Fig. 3 angle $C = 25$ deg. 50 min. Now the active component $= 228 \times \cos B = 205$ kw., and the reactive component $= 228 \times \sin B = 99$ kva.

When this leading load, Fig. 3, is added to the lagging load found by adding algebraically the components in Fig. 4, active kilowatts $= 494 + 205 = 699$, and the reactive kilovolt-amperage $= 532 - 99 = 433$. As the tangent of angle $D = 0.619$, the angle $D = 31$ deg. 45 min. Since $\cos D = 0.85$, the new power factor will be 85 per cent.

Paterson, N. J. NICHOLAS COOK.

IN ANSWER to B. E.'s question, the final plant power factor would be 0.85, as found by the following calculations:

From the 566-kw. load, the kilovolt-ampere load is found by dividing the kilowatt load by the power factor; thus, $566 \div 0.75 = 755$ kva. The reactive kilovolt-amperage $= \sqrt{755^2 - 566^2} = 499.6$, which is lagging, due to the fact there is a lagging power factor in the system.

As the load on the synchronous motor is to be increased, the difference between the present and the proposed amperage load $= 300 - 105 = 195$ amp. Then the added kilovolt-ampere load $= \sqrt{3} \times 195 \times 440 \div 1{,}000 = 148.5$. The corresponding kilowatt load $= 148.5 \times 0.90$ (0.90 is the power factor of the motor) $= 133.7$ kw. The reactive kilovolt-amperage $= \sqrt{148.5^2 - 133.7^2} = 64.6$. The reactive kilovolt-amperage of the synchronous motor in this case is leading and in direct opposition to the lagging reactive kilovolt-amperage of the load. Combining these results with those previously obtained, we find that the total kilowatt load has increased to 699.7, the lagging reactive kilovolt-amperage has decreased to 435, and the kilovolt-amperage load has increased to 832.9. Since the power factor is equal to the actual power divided by the apparent power, we have $699.7 \div 823.9 = 0.85$ lagging. So 85 per cent is the final plant power factor.

J. Y. SHIRLEY.

Engineering Department,
Kelly-Springfield Tire Co.,
Cumberland, Md.

IN ANSWER to the question by B. E., the plant load under the conditions as given is as follows: load $= 566$ kw.; power factor is 75 per cent lagging, total kilovolt-amperage $= -755$, and the reactive kilovolt-amperage $= -498$.

The kilowatt capacity of the syn-

chronous motor while drawing 105 amp. when the power factor is 90 per cent is 72, and the total kilovolt-amperage and the reactive kilovolt-amperage are 80 and 34.8 respectively.

The new plant load conditions without the synchronous motor operating will be: $566 - 72 = 494$ kw.; $\sqrt{494^2 + 532.8^2} = 729$ and the reactive kilovolt-amperes $= -498 + (-) 34.8 = -532.8$.

The new motor load will have the following characteristics: Total kilovolt-amperage = 300 amp. $\times$ 440 volts $\times \sqrt{3} = 228$; the total kilowatt load $= 228 \times 0.9$ (lead) $= 205$; and the reactive kilovolt-amperage $= 228 \times 0.435 = 99.2$. The total load on the plant will then be $494 + 205 = 699$ kw. or $-532.8 + 99.2 = 433.6$ kva.

The tangent of the angle the cosine of which represents the power factor desired may be found by dividing 433.6 by 699. This angle may be found by referring to a trigonometric table. The cosine of this angle is 0.85. So the power factor of the line when the synchronous motor is drawing 300 amp. is 85 per cent, and the total kilovolt-amperage is 0.822.

C. O. VON DANNENBERG.

Electrical Division,
General Engineering & Management Corporation,
New York, N. Y.

Fastening Rotor Bars to End Rings

The heating of the rotor in one of our squirrel-cage induction motors during the starting period affects the soldered connections between the cars and the rings enough to make it necessary to resolder these connections about every 6 months. Will readers tell me how to solder or secure the bars permanently to the rings so as to eliminate further trouble with them? If silver solder, or some other kind, is employed, I should like to know what flux to use, together with any suggestions you can give me on how to do the job.

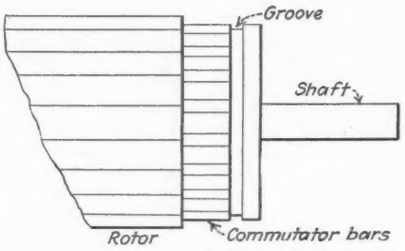
St. Marys, Ont., Canada. W. E.

SILVER solder, as mentioned in the question by W. E., can be used to securely fasten the bars to the end rings in which case borax should be used as a flux. However, a much more substantial job can be made if the bars are welded to the rings. This welding may be done by the acetylene or an electric method. H. E. STAFFORD.

Electrical Engineer,
Provincial Paper Mills, Ltd.,
Port Arthur, Ont., Canada.

IN REPLY to the question by W. E., I have found it very good practice to use acetylene welding to secure rotor bars to the end rings with a good grade of brass or bronze.

In the larger sized rotors, I make a practice of machining a groove $\frac{3}{4}$ in. wide by $\frac{1}{2}$ in. deep (depending on the cross section of the ring) in the end of the rings next to the bars to a depth that is equal to about one-half the depth of the bars, as shown in the accompanying illustration. After this groove is filled by means of acetylene welding, a very permanent connection results. After the welding process is completed, the rotor is placed in a lathe and the surplus metal is machined off.



A GROOVE CUT IN END OF RINGS NEXT TO ROTOR BARS ALLOWS AMPLE CONTACT SURFACE BETWEEN THE SOLDER AND THE ROTOR BARS

Youngstown, Ohio. V. J. WINKLE.

Changing Single-phase Motor for Three-phase Operation

I have a 2-hp. single-phase, 110/220-volt, 1,725-r.p.m., 60-cycle, repulsion-reduction motor that I wish to operate on a three-phase supply. I do not want to rewind the rotor if I can help it, but should like, if possible, to increase the horsepower rating, keeping the speed the same as before. The motor drives a lineshaft from which we operate a small lathe, a drill press and an emery wheel. What will I have to do to this rotor to change it for three-phase operation? When the motor is operated three-phase, will the starting torque be greater or less than it was on single-phase operation?

Farmland, Ind. A. G. B.

IN ANSWER to A.G.B.'s question, it probably would not be necessary to rewind the rotor in order to change to the three-phase operation.

When a single-phase motor is changed to three-phase for the same speed, the horsepower is usually increased automatically. I believe, however, that a squirrel-cage winding would be more suitable in this case. If a squirrel-cage winding is desired, it should be about 80 per cent of the weight of the stator coils when the material is of cast copper, and of cast brass, it should be about three times the weight of the coils. This weight, of course, includes the end rings and the bars in the slots.

A short time ago I rewound a small single-phase machine for three-phase operation. A copper wire band was wound around the commutator under a few pounds of tension. Two copper clips were used under the band, and when the band was finished, it was soldered as is customary with any ordinary banding job.

If the commutator had been of the centrifugal switch type, we would have had to solder a copper circle around the bars. In a case of this kind the switch should be removed.

The motor was rewound for three-phase, four-pole operation, but we found out later that a six-pole motor would have been more satisfactory because of lack of room in the end bells. This made it difficult to place the coils in the stator slots.

GRADY H. EMERSON.

Birmingham, Ala.

Driving Lineshaft By Two Motors

Several machines are operated from one lineshaft in our mill. On some days the load on this shaft is 15 hp. while on others it is 50 hp. We have two 25-hp., constant-speed, shunt-wound motors on hand, and wish to connect them to the shaft through clutches. When the load falls below 25 hp., one motor can be shut down. Will readers tell me (1) whether these motors will operate properly if connected to the same shaft? (2) Is this plan feasible? (3) Is it possible to operate in this manner two constant-speed compound-wound motors, two series motors, or two adjustable-speed, shunt motors?

McKeesport, Pa. E. K.

REPLYING to the question by E. K., the plan of driving the line shaft with two 25-hp. constant-speed shunt-wound motors through clutches, will prove satisfactory providing both motors have the same speed characteristics, and the pulley dimensions are the same. Also, this arrangement of the motors will prove more economical than using one large motor to drive the machinery.

I would not recommend the use of adjustable-speed shunt motors or a compound motor for this installation.

GUY H. WINTERSTEEN.

Cleveland, Ohio.

IN ANSWER to the question by E. K., two shunt-wound motors when connected to the load and operated from the same supply circuit, as described in the question, will divide the load between them in proportion to their capacities provided their speed characteristics are identical. So, if the motors have the same rating, each will carry half the load.

I do not believe that it is practical to operate adjustable-speed motors in the manner suggested in the question.

Ampere, N. J. N. G. WILLEN.

ANSWERING the question by E. K., it may be best in this case to disconnect the shaft and make two group drives instead of having one drive driven by two motors. Some years ago I tried to operate one shaft with two motors and the results obtained were very unsatisfactory. Even if the motors do take their proportionate part of the load, whenever trouble is experienced with one motor, the other motor is then overloaded.

J. T. Slocomb Co., JOHN J. LYNCH.
Providence, R. I.

Mechanical Maintenance of POWER DRIVES

This department will furnish mechanical details of installation, operation and maintenance of equipment in the path of power service from the first mechanical driving element through the auxiliary transmitting equipment to all driven machines.

Using a Variable-Speed Unit to Select Best Operating Speed

PLANTS that do a considerable amount of experimental and development work on new products or processes frequently find it difficult to determine the proper operating speed for the machine when ready for actual production operations to begin.

This problem was solved in one Mid-Western plant engaged in the manufacture of a special raw material used in a wide variety of industries by the installation of a Reeves variable-speed unit.

This unit is used in the experimental and laboratory departments, to assist in determining the proper operating speed during the experimental work, and also for establishing operating speeds for the equipment in actual production.

With this particular type of drive laboratory men are able to vary the speed quickly and easily over a large range and study the effect upon the product and on the output. After the most satisfactory speed is determined in the laboratory the machinery for actual production is connected accordingly.

Before the use of this device it was often necessary to make a number of pulley changes, each of which usually meant a change in belt length, before an approximately satisfactory operating speed was obtained. It was impossible to obtain close adjustments in operating speeds by the old cut-and-try method of adjustment.

This process slowed up the experimental work considerably, and even then the speed determined as a result of the tests was only an approximation.

Chicago, Ill. E. G. H.

Short Center Drive Prevents Pulley Wear Due to Slip of Dusty Belt

BELTS which operate under very dusty conditions must be maintained under sufficient tension or have a large enough arc of contact on the small pulley to prevent slippage; otherwise the dusty belt will cause excessive wear on the pulley faces. The action is similar in this case to an endless abrasive polishing belt.

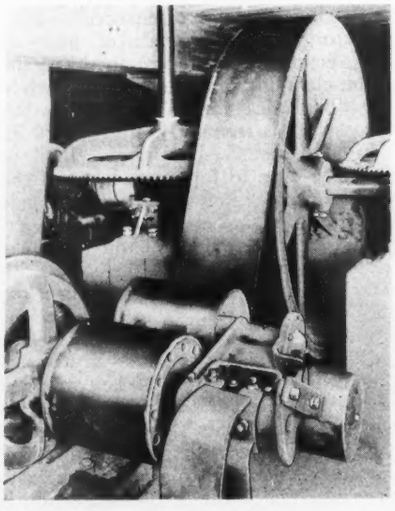
One of the common methods of overcoming this slippage is to use the gravity idler in preference to a high belt tension. In addition, the belt selected must be pliable, tough and have sufficient strength to withstand particularly hard service for a belt.

The accompanying illustration shows a 14-in. double Wabeco (Warren Belting Co.) leather belt installed under very dusty conditions in a hard drive at the plant of the G. F. Wright Steel & Wire Co., Worcester, Mass. This drive has been operating satisfactorily over the Pulmax (Bird Machine Co.) gravity idler for a number of years with an average amount of attention.

Also, a composition pulley is used on the motor to further help reduce the slippage. With the high reduction ratio and short centers, as may be seen from the illustration, an extremely flexible belt is necessary.

When purchasing a belt for any type of hard drive and particularly where much of the severe service is due to the surrounding conditions, such as dust which cannot be prevented, it is especially necessary to consider quality, because life and probable maintenance cost are of paramount importance to assure a low annual belt cost.

HIGH-REDUCTION RATIO DRIVE UNDER DUSTY CONDITIONS IN WIRE MILL



Local Conditions Determine Lubrication Policies and Practices

LUBRICATION policies and practices for various machines in an industrial plant are sometimes determined by the local conditions rather than by the rules generally followed. On ball bearings in textile mills, for example, it is often preferable to use grease instead of oil. This is because there is less likelihood of leakage than with oil. Also, a mixture of lint, fluff, and other material of this kind, with oil, is highly inflammable.

There is always the risk of oil falling on the fabric and it is practically impossible to remove mineral oil stains from fabric without damaging it. One of the lubrication practices often followed is to apply a mixture of animal, vegetable and mineral oil in cases where oil must be used, because a stain resulting from such a mixture can be removed. Another lubricant, which is sometimes used in such cases, is a mixture of sperm and castor oils, in equal proportions; this has proved to be an efficient lubricant and its stain can also be removed.

Lubrication of the spinning machine spindles is important because sometimes as much as 15 per cent of the power used in the spinning department may be friction loss resulting from bad lubrication; proper lubrication, therefore, offers opportunities for substantial economies here. Because of the high speed and small clearance between the spindle and the bolster, a light oil is essential.

Where there is any doubt about the oil used. a test can be made on a machine driven by an individual motor or, if this is not available, on a small group of machines. It is necessary first, however, to correct any unsatisfactory operating conditions of the machines. Each of the oils chosen should be tested for at least a week. Particular attention should be given to the temperatures of the bearings in operation with each oil and meter readings taken of the power consumption at the end of the week. Better results may be obtained by the use of graphic meters. It will probably be found that the amount of power used with different grades of oil will vary considerably. The oil which shows the lowest power consumption should be used provided that the spindles do not overheat. While making these tests it is absolutely necessary that the work done on the machines should be fairly constant, otherwise such a test would be useless.

Brentford, England. W. E. WARNER.

In the REPAIR SHOP

This section is devoted to repair work on electrical and mechanical equipment. Special attention is given to shop or bench tools and short cuts or improved methods of handling work of this character. Contributions are always welcome.

Reconditioning of Direct-Current Commutators

ALTHOUGH commutators are often subjected to much abuse, such as being allowed to become oil soaked, to have flat spots and grooves, and to be fitted with brushes of improper characteristics, yet the life of a commutator averages from one to three armature windings.

When a commutator requires new mica segments or needs refilling, the old segments should be checked with a micrometer and replaced with new segments of the proper thickness. If this is not done, trouble may be experienced in tightening the commutator when reassembling.

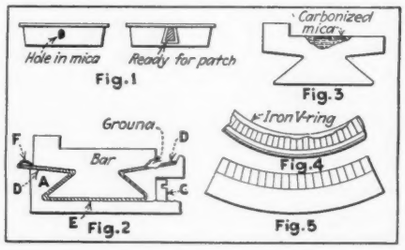
The insulating segments between the bars are of amber mica in a built up form and range in thickness from 0.015 in. to about 0.045 in., the thickness depending upon the diameter of the commutator and the voltage between the bars, which is seldom over 30 volts, the average being about 15.

The Canada amber mica used for segments is made in built up sheets, and the binder used is shellac or some kind of gum. These sheets, which are about 18 in. x 36 in., can be obtained in various thicknesses. Consequently the average repair shop would require only three or four thicknesses. The segment mica is usually marked with a label of a different color than that used on molding mica. Also it is lighter in color than the molding mica but does not mold; and if heated it will disintegrate.

If only a few mica segments are charred or defective, Fig. 3 in the accompanying illustration, the V-ring may be removed and one commutator bar unsoldered for a pattern. The defective mica can then be scraped out with a sharp hook-like tool made of an old hacksaw blade. After this is done, the cavity may be filled with patented commutator compounds, with powdered mica and shellac, or shellac and plaster of paris. The mica segment in the rough should be about $\frac{1}{16}$ in. longer and wider than the commutator segment in order to furnish sufficient stock.

When a small hole has been burned through a mica segment, the small holes can be patched by removing the clamping ring. Then the mica should be cut out as shown in Fig. 1. The patch is made of two pieces of mica. The one on the bottom next to the iron ring is made smaller than the top patch, a $\frac{1}{4}$ to $\frac{1}{8}$ in. margin being allowed. These pieces, which are made of molding mica, are tapered toward the outside, for by so doing they are prevented from being backed out as pressure is applied when tightening the commutator. After the mica has been shaped to the ring curvature, it should preferably be shellacked in place with orange shellac, which is clean, free from lumps, reasonably thick, has a small amount of rosin dissolved in it, and made up with gum and alcohol, for the prepared shellac is usually too thin for this purpose.

Fig. 2 shows the usual method of insulating a commutator bar and also the place where most grounds occur. The cylinder *E* is not used in all commutators, but it is an added safety factor. The cord band shown at *F* should be used on both ends of the assembly and it is a good idea to paint it with shellac, for this resists moisture better than paint.



WHERE COMMUTATOR MICA GENERALLY GIVES TROUBLE

With traction motors, cranes, railway and mining machinery, grounds through the V-ring insulator often occur. This insulator, which is made of molding mica, is made to conform to the shape of the clamping rings by molding while hot. The mica varies in thickness but the average is from 0.045 in. to 0.070 in.

Figs. 4 and 5 show the method of cutting a ring to form one layer of the V-insulator. After a pattern is made from the V-ring out of heavy paper, enough stock is added to this to make the complete V. Warm the mica with a torch before forming around the ring, and where the ring laps, it should be beveled about an inch. In this case the shellac is applied to both surfaces of the mica. Wire or cord is then wrapped or twisted around the mica, which is warmed until it fits the ring perfectly. Apply sufficient heat to drive out all surplus shellac and to stick the mica to the ring. Then the scalloped portion is bent down and formed all the way around the ring, and when this operation is completed the bars and mica are sandpapered. After the high spots are trimmed down with a wood chisel or sharp knife, the other layer is applied. Make the joint of the second layer correspond with that of the first one. Now the whole ring can be refinished and be made ready for assembly. It is always advisable to use two or more layers of mica in the forming of a new ring insulator, for this insures a perfect insulation if the joints are staggered.

This inside scalloped portion may be made by pressing down on the mica with a babbitt form, which has been made in the ring itself, or the forming may be completed by clamping the ring.

As a ring cannot be made in one piece on large commutators, they are made up of a number of separate pieces with the joints staggered. In this case the commutator may be heated with a torch, being careful not to overheat the comutator assembly. After tightening the assembly, the winding is installed, but before soldering the commutator, tighten the bolts or nuts again.

While soldering the risers it is a good plan to work them up tight. If the risers clamp well, they may be soldered on the side of the armature. When soldering large commutators they should be heated with a torch as the iron is applied; the work will be speeded up in this way. Burnley's soldering paste is almost universally used in preference to flux solder on commutator work. The surplus paste should be removed with gasoline or alcohol after the job is finished and before painting. For large d.c. machines, a 6- to 10-lb. iron is used, a slot being drawn in the point of the iron to help distribute the heat. On deep soldered commutator bars the armature should be tilted so as to prevent the solder from running back of the bars and causing short circuits.

After the soldering operation and while the commutator is still warm, tighten the bolts again if possible. When the armature is taken from the baking oven, the bolts should again be inspected for tightness.

If a bar should rise in operation, it should be carefully tapped down and the commutator tightened. Then it should be turned, filed or ground with a stone, and finished with fine sandpaper. There is a general impression that all commutators should be milled, but this is not the case, for milling depends on its proposed service, the mica segments and the hardness of the brush.

GRADY H. EMERSON.
Birmingham, Ala.

NEW EQUIPMENT

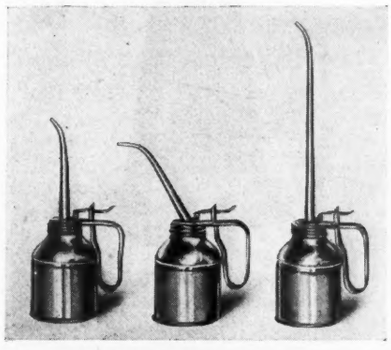
For Plant Operation and Maintenance

Industrial plant executives concerned with the selection and operation of mechanical and electrical equipment will be interested in these new devices which are designed to improve plant operation or reduce operating and maintenance costs.

Positive Pump Oiler

THE production of a line of positive pump oilers, three types of which are shown in an accompanying illustration, have been announced by the Plews Oiler Co., 405 Boston Block, Minneapolis, Minn. This oiler is made in six styles and in sizes ranging from ¾ pint to 1 quart in capacity. It is said to pump light or heavy oil in warm or cold weather, and will exert a pressure at the spout of 100 lb. per sq. inch.

The cans are made of steel, copper plated. The pump action is controlled by a thumb lever mounted on top of the handle. According to the manufacturer, the pump action is by telescoping tubes with ball valves in the bottom of both the movable and the stationary tube. Upward movement of the outside sleeve



Three Types of Plews Positive-Pump Oiler

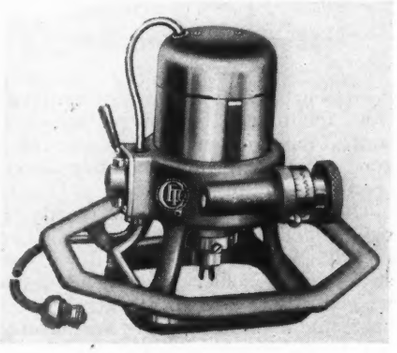
forces oil into the upper chamber, which is constantly filled with oil by reason of the ball check valve. The position of the outside movable tube is such that the container may be practically empty before the container pump will cease working. The quantity pumped is controllable.

Light-Weight Router

RECENT advances in the desigu of universal type motors prompted the Cincinnati Electrical Tool Co., Cincinnati, Ohio, to design its router.

In its construction ball bearings are used and the method of direct drive is also claimed as a feature. To prevent the entrance of dirt or grit and the escape of lubricant, felt washers, which are protected by metal retaining rings, are employed.

The adjustment stop on this machine is graduated to 1/16th, and a turn of



Cincinnati ¾-hp. Router

the stop-pin release allows the router to move freely in the slideway for the full length of its travel. A knurled hand wheel, operating through a rack and pinion, provides a rapid and positive method of lowering the cutter into the work. This method of control, it is claimed, is ideal for cutting rosettes, fluting, boring, and the like.

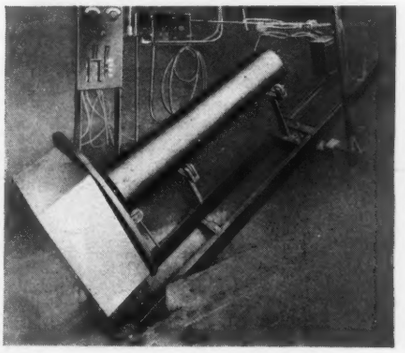
This machine is sturdily constructed and weighs 30 lb. The ¾-hp. motor operates at a speed of 12,500 r.p.m., thus making possible, it is claimed, a clean and finished cut. This router can be furnished wound for 110 or 220 volts, for operation from either a lamp socket or power line.

Automatic Tank Welder

A NEW carbon arc, automatic welding machine has recently been put on the market by the Lincoln Electric Co., Cleveland, Ohio. This machine is designed primarily for the purpose of welding the heads in range boilers.

The rotating table is driven by a small

Lincoln Electric Automatic Welder for Range Boilers

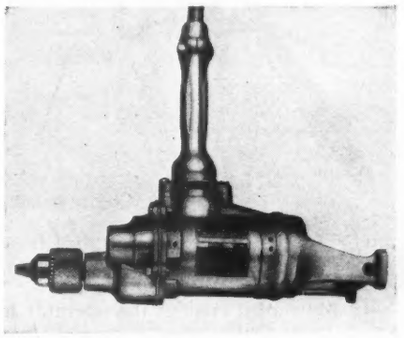


variable-speed motor that provides speed adjustments for tanks of various diameters. Roller rests are also provided, which maintain the alignment of the work. The carbon electrode is carried by an adjustable arm supported from a rigid pedestal on which the motor starter is mounted. No filler metal is required in this operation; the head being flanged and inserted so that a lap joint is secured as in a riveted tank. The heat of the arc, the manufacturer claims, melts the edge of the lap weld of the cylindrical sheets, fusing it with the head and forming a solid, leak proof joint.

On 14-gage material, seams have been welded at the rate of 135 ft. per hour, it is claimed. While these machines were developed primarily for welding range boilers, they are equally applicable for welding all kinds of small cylindrical tanks.

High-Frequency Electric Tools

A NEW line of Thor high-frequency electric tools, with squirrel-cage motors operating on 180-cycle current, have been developed by the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. The type of motor employed in these tools eliminates armature windings, commutators, and brushes, which are said to have been



Thor High-Frequency Electric Drill

the seat of trouble in universal-motor tools. The Thor rotor has solid copper bars, riveted and welded in position. The gears are made of special high-grade steel to withstand severe service. The stator case and gear case are of heavy aluminum.

One of the important features claimed for this new line of tools is their constant speed from no load to peak load. It is stated that there is no slip in speed under load with these tools as compared with universal motor tools. Another important feature is the size and weight, which are said to be about one-third of those of a tool operating on 60-cycle current. This results in easier handling by the workman, thus assuring increased production.

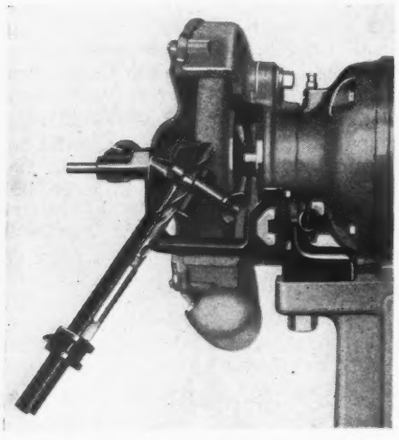
To use high-frequency tools it is necessary to install a frequency changer to step up the frequency of the current to 180 cycles. However, according to

the manufacturer, the advantages are such that any shop having ten or more portable tools in use will find it both profitable and practical to make the change.

The tool illustrated is a ½-in. high-frequency drill, weighing 10¼ lb. and operating at 650 r.p.m. The Thor line of 180-cycle induction-type motor electric tools is composed of drills, reamers, screwdrivers, tappers, nut setters, grinders, and sanders.

Twist Drill Grinding Attachment

THE twist drill grinder illustrated has been brought out recently by the Hisey-Wolf Machine Co., Cincinnati, Ohio. This attachment, according to the manufacturer, is a complete, self-contained unit doubling the utility of the grinder on which it is used, as it affords the dual advantages of two distinct machines. The complete unit is interchangeable with the standard tool grinding rest on Hisey grinders, and can be quickly mounted in position.



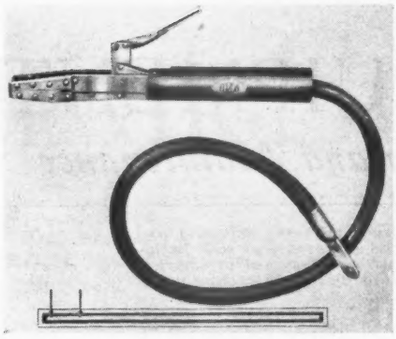
Hisey Twist Drill Grinder Fitted to 10-in. Wheel

This attachment enables the operator to grind twist drills more accurately and also quicker than the old and obsolete free-hand method. It eliminates the use of gages; a graduated micrometer screw adjustment insures identical lip lengths.

A 60-grit grinding wheel of medium grade is recommended and should be dressed frequently so as to retain a straight face. The attachment can be used to grind straight- or taper-shank twist drills from ¼ to 1¼ in. in diameter.

Electrode Holder

THE Fuzon electrode holder for metallic and arc-welding electrodes of all classes, particularly surfaced electrodes, has been designed by the Fuzon Welding Corp., 103d St. and Torrence Ave., Chicago, Ill. The holder, which is shown here, is said to minimize overheating of the electrode and to give perfect contact under any and all conditions. When the electrode is placed in the holder, the jaws clamp and the electrode is automatically pushed forward. This



Fuzon Electrode Holder

movement scrapes all surface materials from the four points of contact, it is stated, thus insuring the welder of a good contact and eliminating overheating.

The electrode stub ends are readily removed and new electrodes easily inserted. Spattered weld metal will not stick to the holder jaw. The device weighs 2 lb. and 3 ft. of extra flexible cable and a connecting lug are included with each holder.

Floodlight Projector

A NEW 24-in. floodlight projector, known as the type SCA-24, has been developed by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., particularly for railroad yard lighting and similar applications where long throw and high beam candlepower are essential.

The large diameter of the reflector in the new floodlight permits, it is claimed, a wide angle of light with high overall efficiency, and its long focal distance gives good beam concentration for long range work.

The 24-in. parabolic chromium-plated brass reflector is mounted in a cast aluminum alloy frame with a spun sheet aluminum back. The lens, of heat-resisting glass, is held in a door, which opens from the front swinging sideways. Thus, it is possible to renew lamps and clean the reflector without interference from the door.

Westinghouse SCA-24 Floodlight Projector

The floodlight is mounted so that it can be tilted upward where its position is such that approach from the front is not practical. A stop is provided so that it is unnecessary to aim the projector each time it is moved from position. Focal adjustment is provided by three screws, which operate independently, two for "in" and "out" and lateral motion of the lamp, and one for adjustment of focal distance.

The reflector is entirely inclosed, no ventilation being required. It is furnished with either narrow or wide beam projector and with either a plain or spread lens. The visor is supplied as an accessory.

Combination Buffer and Disk Grinder

ANOTHER addition to the line of new and redesigned electrical tools manufactured by the Standard Electrical Tool Co., Cincinnati, Ohio, is shown

Standard Electrical Tool Co. 2-hp. Combination Buffer and Grinder

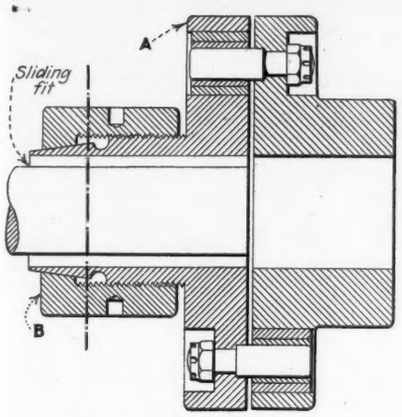
in the accompanying illustration. This combination buffer and disk grinder is made in four sizes rated at ½, 1, 2 and 3 hp. respectively.

The armature shaft is made of nickel steel and is fitted with three SKF ball bearings which are incased in dust-proof casings. A push-button control is mounted on the pedestal within convenient reach of the operator. The steel disk is 12 in. in diameter and is reversible. The 7x14-in. disk table has both horizontal and vertical adjustment.

Flexible Coupling

A TYPE of tension-sleeve coupling designed to facilitate quick changes in direct-connected drive or to permit using one motor to drive different machines at different times is a recent development of the Ajax Flexible Coupling Co., Westfield, N. Y.

The coupling, which is a modification of the Ajax rubber-bumper coupling, is designed so that the flange *A* attached to the driven shaft is readily removable. This flange is made with an extended split hub having a taper on the outside



Ajax Tension-Sleeve Flexible Coupling

and a straight threaded portion as shown. A collar *B* is made to fit over the threaded hub and when screwed up to a tension fit, tightens the hub to the shaft, the hub being further held in place by setscrews fitted over two sliding keys.

The removable flange *A* and collar *B* are of steel, and the other parts are identical with the standard couplings made by this company and are therefore interchangeable in case of accidental breakage. The coupling flanges are connected by means of special bolts and rubber bushings.

Portable Single Unit Blower

A PORTABLE blower known as the "Coppus Heat Killer" has been put on the market by the Coppus Engineering Corporation, Worcester, Mass., for the purpose of reducing the effect of heat radiation on workmen.

The blower, which is mounted on three legs, normally stands 4 ft. from the floor. By means of an adjustable connection the blower can be moved to a vertical angle, in order to direct the air blast to that zone that is desired to be cooled.

These portable blowers are furnished in two sizes; namely, No. 175, which weighs 118 lb., and is fitted with a ½-hp. universal motor adaptable for either 110 or 220 volts, and the No. 250, which weighs 265 lb., is fitted with a 1-hp. motor that can be furnished for operation on a.c. or d.c. lines with voltages ranging from 110 to 550.

Coppus Engineering Corporation Portable "Heat Killer" Blower

Light-Duty Tier Tructor

A NEW, light-duty, 2-ton, electric tiering tructor has been added to the Mill-Type Series of the Elwell-Parker Electric Co., Cleveland, Ohio. This machine, as illustrated, is designed to handle skid loads, as in regular power-lift truck service, or to elevate the load 4 to 8 ft. from the floor when tiering or stacking in storage, or stockroom, or delivering goods to motor truck or to railroad car from rail level to car floor.

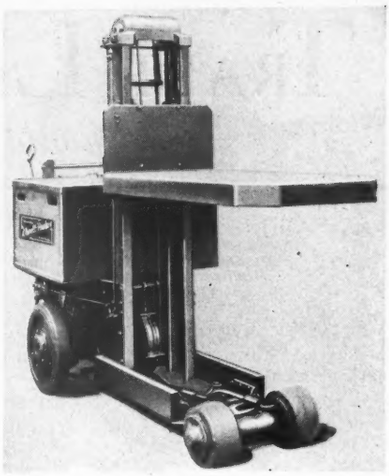
The new machine is of all-steel construction and built on the interchangeable-parts basis. The power plant is of the unit type, with inclosed Elwell-Parker motor, steel brake-drum, steel multi-thread worm-to-bronze differential, chrome-vanadium drive shafts, and universal joints to permit steering and to deliver power to the steel clutch plates bolted to the outside of the drive wheels, which are fitted with solid rubber tires and Timken tapered bearings. The third point support of the power plant is a ball beneath the drive motor.

The operator's pedals, one for the brake, the other for the controller reverse drum, which trip to off-position when pedal is raised, are constructed with a heel rest and non-slip surface, and are spring folded when operator leaves truck. The braking and power application is separate to provide for incline operation. Elwell-Parker heavy-duty, drum-type controller is also used on this machine. All fingers are fitted with reversible tips and the controller contacts are automatically lubricated by a special attachment. The removable controller handle returns to the off-position when released.

The lift controller, located beneath the driving motor controller, is also of the drum type. An automatic trip returns the drum to the off-position when the load platform reaches its highest or lowest point or it can be returned to off-position manually at the will of the operator.

The lift is effected by means of a standard Elwell-Parker, inclosed-type motor with spur-gear reduction to double-grooved drums carrying steel cable which runs over sheaves at top of the uprights to sheaves on elevator carriage to cable equalizer. Cable tension is maintained automatically.

The main frame is built of angles, channels and heavy gusset plates with flanged edges riveted into a rigid box frame. The steering mechanism is of the ball and socket type and steering is effected by means of an adjustable horizontal lever, fitted with a push button connected to high grade electric horn. The entire unit is Alemite lubricated. The trial axle has 10x6-in. tires and tapered Timken bearings.

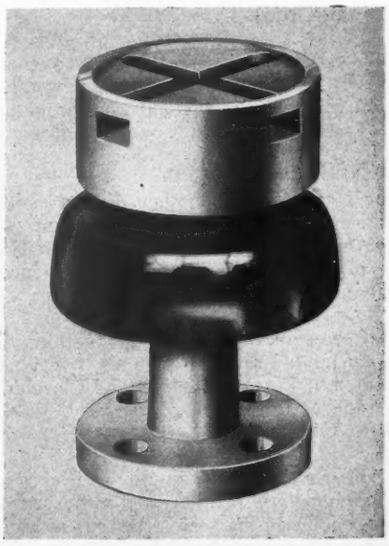


Ellwell-Parker 2-Ton Tiering Tructor

4,500-Volt Insulator

DEVELOPMENT of a new outdoor bus support for 4,500-volt service is announced by the Line Material Co., South Milwaukee, Wis. This unit is designed and constructed for use with any of the high-tension equipment manufactured by this company. It is interchangeable, in that any of the seven types of clamps may be fitted upon the cap and the unit can be mounted on any type of base. The cap and pin are of malleable iron cemented on to the brown-glazed, wet-process insulator. Both the pin and cap are hot-dip galvanized.

4,500-Volt Insulator for Outdoor Bus Supports. Manufactured by the Line Material Company



TRADE LITERATURE
You Should Know About

Copies of literature which is described on this page can be obtained by writing to the manufacturer whose name and address are mentioned. It is always advisable to state the name and number of bulletin or catalog desired, as given in these columns.

TRANSFER SWITCHES—Form 56 describes and illustrates the Sundh automatic transfer switch for changing a load from one source of supply to another.—Sundh Electric Company, Inc., 5 Avenue C, Newark, N. J.

CHAIN HOISTS—Bulletin 21 describes the new Ideal spur-geared ball-bearing chain hoist. — The Dickerman Hoist Manufacturing Company, 872 East 72nd St., Cleveland, Ohio.

REFLECTORS — Abolite reflectors for every industrial lighting need. Write for Catalog 179, which gives full information on industrial lighting requirements.—National Screw & Manufacturing Company, 2500 East 71st St., Cleveland, Ohio.

ELECTRIC HEATERS—Bulletins describing complete electric portable and stationary heaters and electric strip heaters.—The Martindale Electric Company, 1252 West 3rd St., Cleveland, Ohio.

TRANSFORMERS — Bulletin 1027 announces the new type three-phase autotransformer.—Sorgel Electric Company, 91 West Water St., Milwaukee, Wis.

MOTORS—The new Wagner split-phase motor, type 58 RDT, is completely described in Bulletin 153.—Wagner Electric Corporation, St. Louis, Mo.

FIRE EXTINGUISHER—A folder announces the new Phomene Accumulator designed for automatic foam fire protection.—Pyrene Manufacturing Company, Newark, N. J.

UNIT HEATERS — Form 6818 completely describes the Venturafin installation in the new Oakland-Pontiac plant. —American Blower Company, Detroit, Mich.

SILENCERS—A number of interesting industrial applications of Maxim silencers are described and illustrated in a new bulletin.—The Maxim Silencer Company, Hartford, Conn.

CONVEYORS—Various applications of Cleveland Tramrail systems are illustrated in Form TR-563.—The Cleveland Crane & Engineering Company, Wickliffe, Ohio.

SCALE DRAWING FOLIO — Electrical draftsmen will be interested in the seven-page folio giving scale drawings of high-tension equipment. These engineering sheets give scales of $\frac{1}{8}$ in., $\frac{3}{16}$ in., $\frac{1}{4}$ in., $\frac{3}{8}$ in., $\frac{1}{2}$ in., $\frac{3}{4}$ in., and 1 in. to the foot.—Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Ill.

INSULATORS—"Lead Tip Steel Pins for Insulators" is the title of a new booklet recently issued.—Ohio Brass Company, Mansfield, Ohio.

COMPRESSORS—Folder GEA-233A describes GE centrifugal single-stage air compressors with a volume range of from 250 to 75,000 cu.ft. per minute. —General Electric Company, Schenectady, N. Y.

SHOCK ABSORBERS—A new general bulletin recently issued describes the Ajax industrial absorber. This book is complete with illustrations and data.—The Ajax Flexible Coupling Company, Westfield, N. Y.

GEARS AND SPEED REDUCERS—Catalog 123 has recently been issued completely describing James generated continuous-tooth, herringbone gears and reducers.—D. O. James Manufacturing Company, 1120 West Monroe St., Chicago, Ill.

CABLE—A folder has been issued describing Wireflex non-metallic sheathed cable with "Wimo" slick finish.—The Wiremold Company, Hartford, Conn.

ELECTRICAL EQUIPMENT — Catalog 110 sets forth a complete line of railway and industrial electrical equipment manufactured by this company.—The Pyle-National Company, 1334-1358 North Kostner Ave., Chicago, Ill.

METERS—Bulletin W-821 contains an interesting pictorial visit to the Worthington meter factory at Harrison, N. J.—Worthington Pump & Machinery Corporation, 115 Broadway, New York, N. Y.

MOTOR STARTERS — General advantages claimed for the use of Allen-Bradley starters for alternating-current motors are discussed in a folder.—Allen-Bradley Company, 491 Clinton St., Milwaukee, Wis.

FIRE EXTINGUISHERS — Advantages claimed for Fyre-Freez, which uses carbon dioxide liquefied under pressure as the extinguishing agent, are explained in a folder. This gas when released freezes into a dry carbonic snow with temperature of 110 deg. below zero. Fyre-Freez, it is said, can be used on electrical fires and also is effective on gasoline, oil, paint, varnish, lacquer, and carbon bisulphide fires.—Fyre-Freez Corporation, 17 West 46th St., New York, N. Y.

LIFT TRUCKS — A series of folders illustrates applications and gives specification of the Blue Streak side-lift and the Model K heavy-duty Stuebing-Cowan hand-lift trucks and steel-bound platforms.—The Stuebing-Cowan Company, Cincinnati, Ohio.

SAFETY LADDER — Features of the construction of the Dayton folding safety stepladder are illustrated and described in a 12-page booklet.—The Dayton Safety Ladder Company, Miamisburg, Ohio.

WORM GEARING—Catalog 400 devotes 24 pages to a discussion on worm gearing and the use and application of IXL Moderntype worms and worm gears in industrial equipment.—Foote Bros. Gear & Machine Company, 236 North Curtis St., Chicago, Ill.

VARIABLE SPEED TRANSMISSION — A folder describes and illustrates the use of the splice block for facilitating changing the *V*-belt in the Reeves transmission.—Reeves Pulley Company, Columbus, Ind.

UNIT HEATER — Catalog 26, section 2-A, devotes 20 pages to engineers' data on the selection and installation of York welded-coil unit heaters.—York Heating & Ventilating Corporation, 1502 Locust St., Philadelphia, Pa.

SPEED REDUCER—Book 715 discusses the rating, describes the construction and gives other engineering details on the three types of Link-Belt speed reducers with Sykes continuous-type herringbone teeth.—Link Belt Company, 300 West Pershing Road, Chicago, Ill.

MOTORS—Some interesting installations of Reliance reversing motors are illustrated in Bulletin 1064.—Reliance Electric & Engineering Company, 1053 Ivanhoe Road, Cleveland, Ohio.

WORM REDUCERS—Application of various types of Cleveland worm reduction gears to small loads, direct-connected loads, overhung gear-shaft loads, vertical drives, and units for high reductions is speed is discussed in Bulletin 106.—The Cleveland Worm & Gear Company, 3268 East 80th St., Cleveland, Ohio.

MONORAIL INSTALLATION—A 20-page supplement for insertion in Monorail Catalog 8 contains 18 dimensioned blueprint pages showing standard methods of steel and wood framing for monorail switches and curves. Catalog 8 devotes 106 pages to descriptions of monorail equipment with illustrations and blueprint diagrams of installations which have been made in various industrial plants throughout the country. — The Louden Machinery Company, Fairfield, Iowa.

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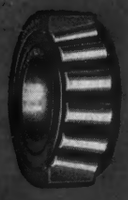
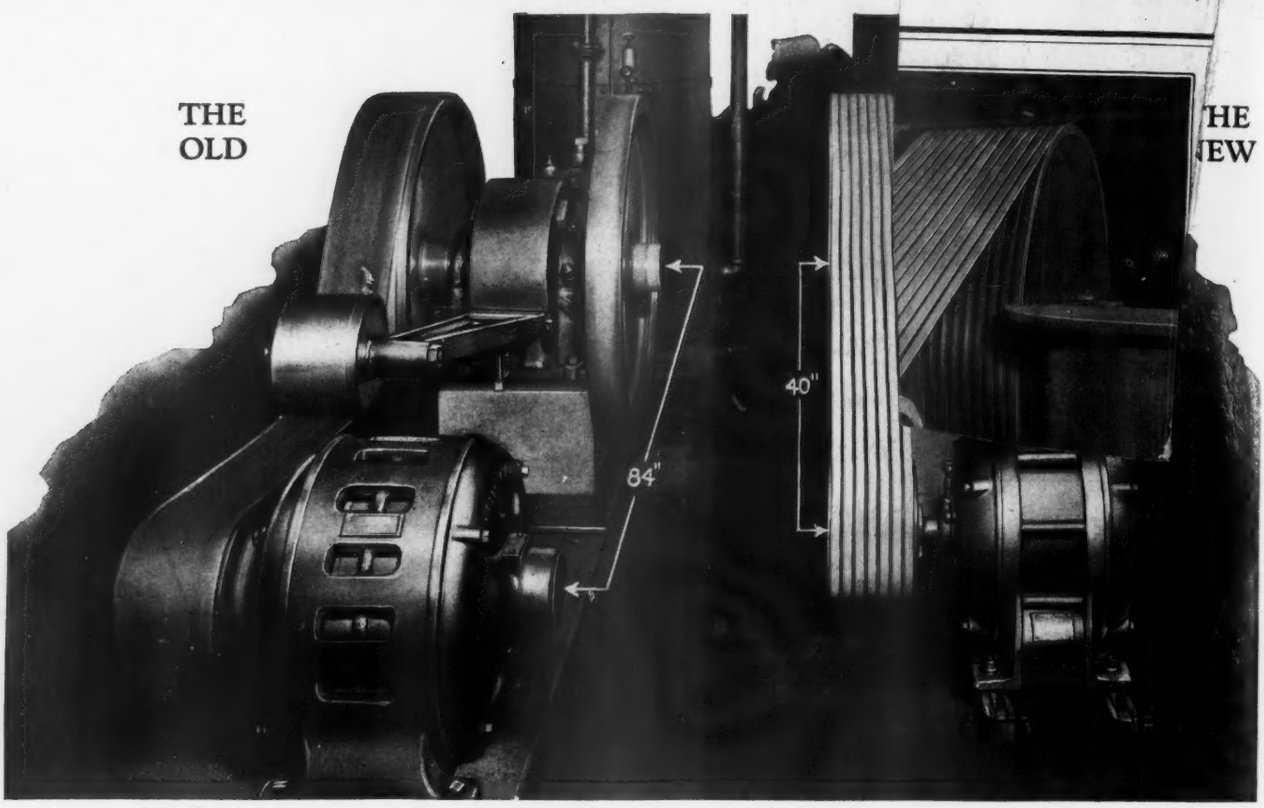


Timken-Equipped Allis-Chalmers back-geared motors driving agitators in Swift paper mill, Middletown, Ohio

The least electric motor trouble can now be expected exactly where you once had the most — in the bearings. Mere anti-friction bearings couldn't have done it. Only Timken Bearings with their higher capacity for thrust and radial loads, their Timken tapered construction, Timken-made electric steel, and Timken *POSITIVELY ALIGNED ROLLS* produce the record-breaking endurance and economy of Timken-equipped motors.

More compact, more simple, and lending themselves to more precise design and assembly, Timken-equipped motors stay "like new" with lubrication a few times yearly at most.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO



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Duplicate Compressors, operating at same capacity and pressure.

THE NEW UNIT EMPLOYING TEXROPE ELIMINATES THE IDLER.

The 40″ pulley centers on the new unit is less than one-half of this dimension on the flat belt driven unit.

The short belt centers made possible by Texrope Drive and the compactness of the Allis-Chalmers motor with Timkin Bearings result in a big saving in floor space.

The Texrope requires no lubrication; dust does not affect it. The motor is made largely of steel — indestructible rotor — extra sealed insulation — grease packed bearings which require attention only a few times yearly. These features reduce maintenance to a negligible item.

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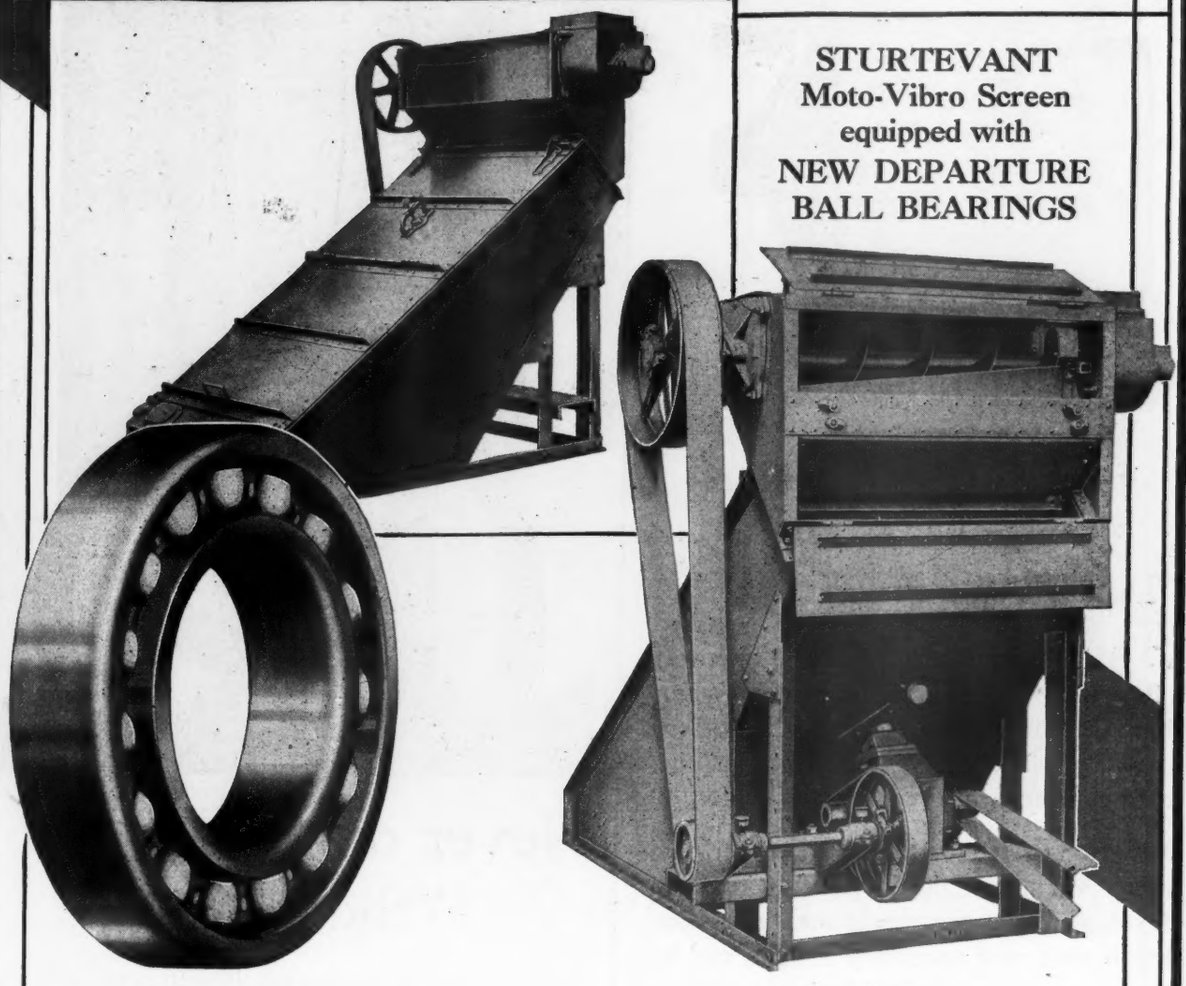
A Combination Unequalled!



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NEW DEPARTURE
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NEW DEPARTURES support vibrating and rotating parts without decentering and without measurable wear at all speeds and under peculiar conditions of high frequency such as occur in the vibrating mechanisms of the screen illustrated above.

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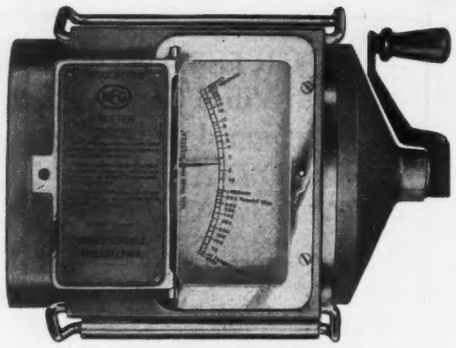

Top View of
"MEG" Insulation Tester
Weight 6¾ lb.

"Megger" tests avoid expense of six electricians—

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We are told that this plan of periodic inspection has made it possible to keep the electrical apparatus in such good condition that any necessary repairs can be made *in port*, and therefore it has been possible to omit an electrician from the crew of each boat while at sea.

Such action *again* supports our well-founded claim that it "*pays*" to use "Megger" Instruments.

Pocket Manual of "Megger" Practice, No. 1150-W, containing 80 pages of helpful information and illustrations regarding the use of "Megger" Instruments, will be mailed upon request.

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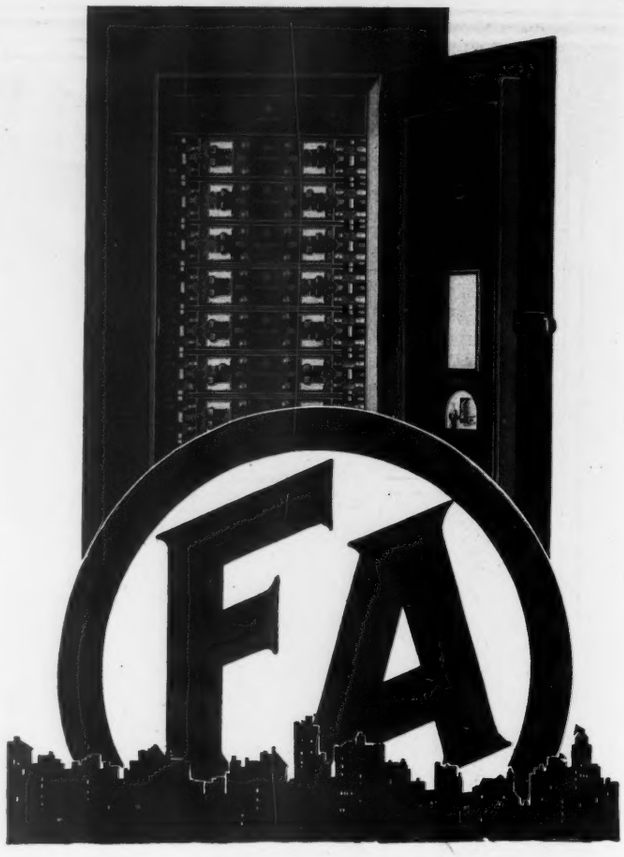

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A man's ability to stay on the job is an index of his worth—so it is in the case of factory panelboards.

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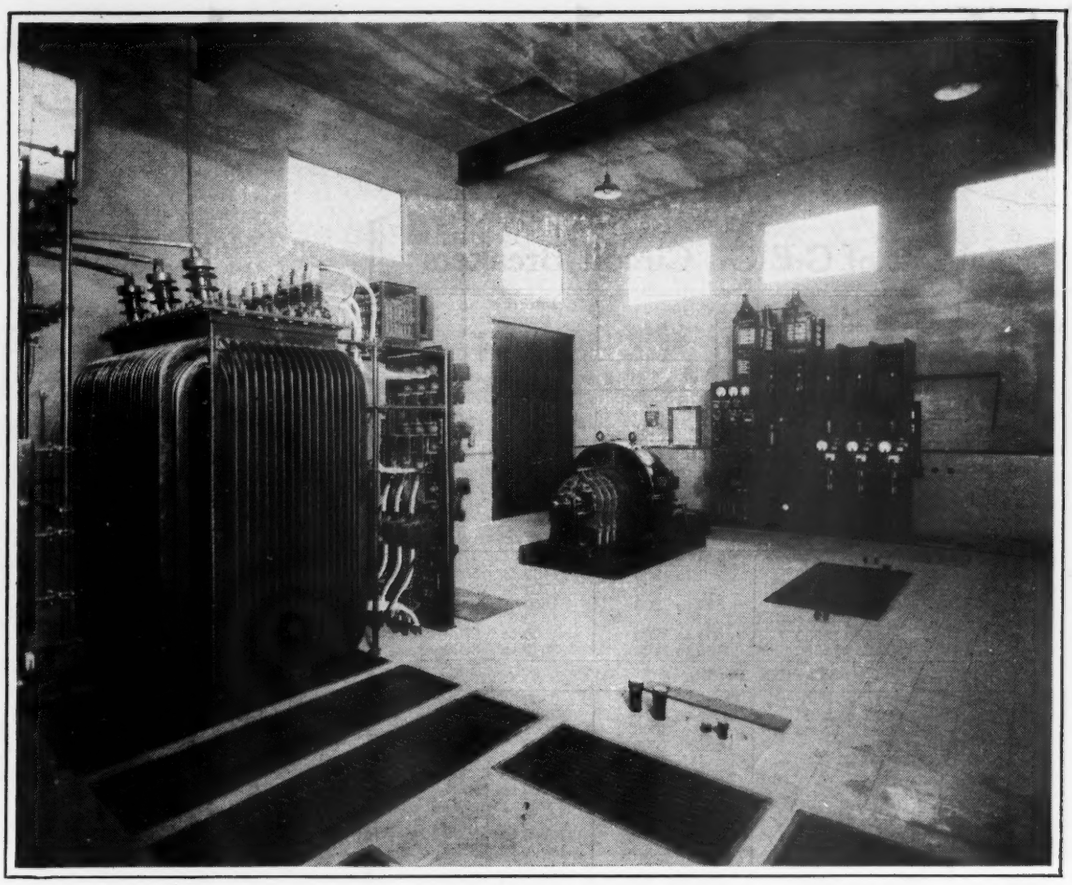
Brooklyn, N. Y.	Detroit, Mich.	New Orleans, La.	Toronto, Ont.
Buffalo, N. Y.	Kansas City, Mo.	Omaha, Nebr.	Vancouver, B. C.
Charlotte, N. C.	Los Angeles, Calif.	Philadelphia, Pa.	Walkerville, Ont.
Chicago, Ill.			Winnipeg, Man.



In the first full automatic railway substation in San Francisco

EVIDENCE of the ability of correctly chosen National Pyramid Brushes to stand not only normal loads, but prolonged overloads, is to be had in San Francisco. There the Market Street Railway Company has on San Bruno Avenue the first full automatic railway substation to be erected in that city. It is equipped with a 750 Kw., 600-volt, 1250 r.p.m. rotary converter. This machine operates at 75 per cent of its rated capacity, except during the rush hours. Between 7.30 and 9 in the morning and 4 and 6 in the afternoon the converter carries 100 per cent overload.

National Pyramid Grade 259 was supplied as original equipment on the DC side of this machine, and is carrying not only the normal loads but also the overloads with practically sparkless commutation.

National Pyramid Grade ET-10, on the AC side, was also part of the original equipment.

Our Sales Engineers are at the service of both manufacturers and users of electrical equipment. In many cases they have been able to end vexing brush troubles; and in others to add to the capacity and utility of equipment. Write, wire or phone and the experience of these men will be put at your disposal.

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide UCC *and Carbon Corporation*

Cleveland SILVER STRAND CABLE TRADE MARK REGISTERED San Francisco

Emergency Service Plants are located in

CHICAGO PITTSBURGH NEW YORK, N. Y. BIRMINGHAM

Engineered Units – Stock Prices

FALK Speed Reducers are standardized for any duty. New rating tables make selection of the unit easy. Shipment is made from stock on standard ratios — immediately!

Falk Speed Reducer rating tables are a guarantee of capacity. Provision is made for 100 per cent overload starting capacity.

Purchasing departments and engineers should have price lists and bulletin on these new units.

Get Falk quotations on your present requirements for comparison.

Bulletin Number 160, containing rating tables and full dimensions, with new price lists, sent on request.

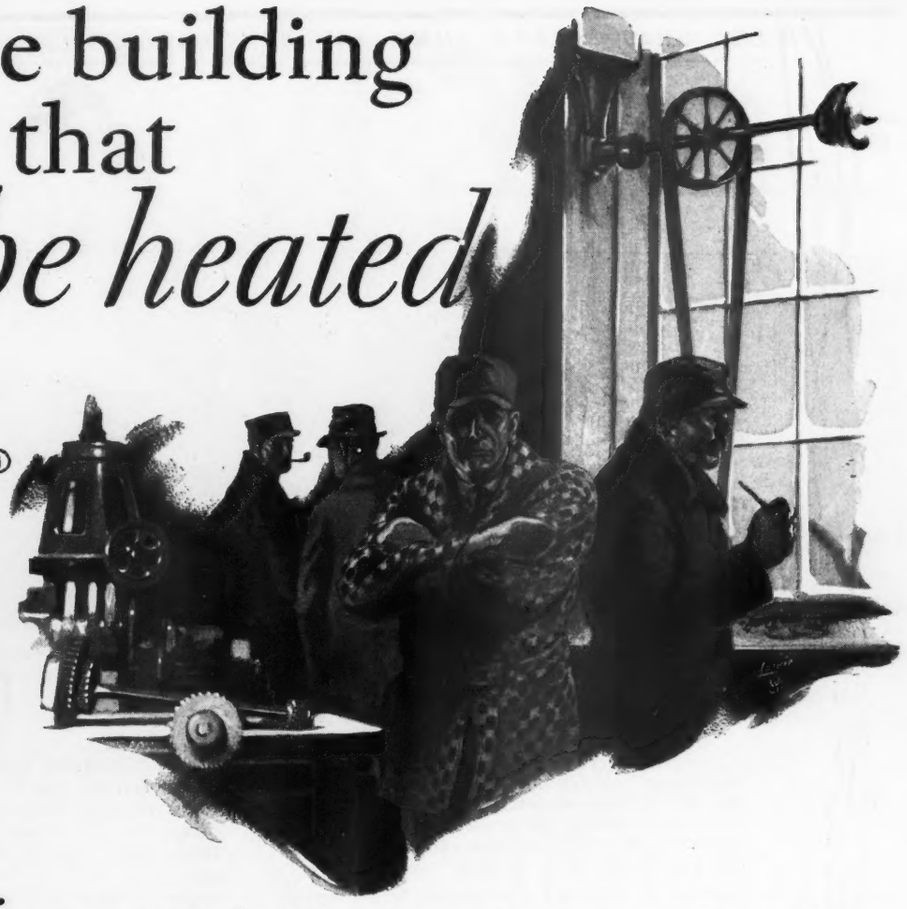
The Falk Corporation

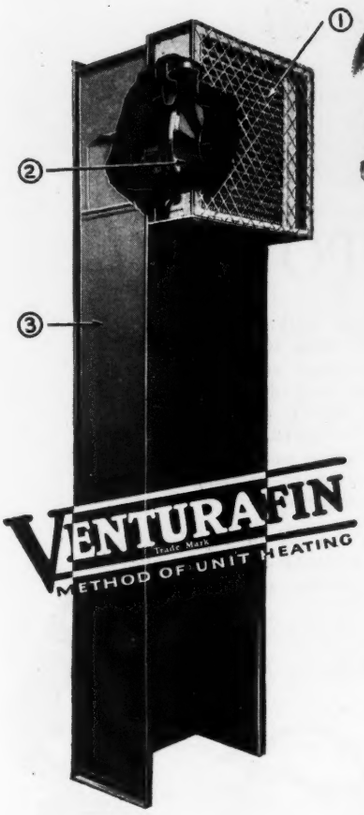
New York Albany Detroit Chicago
Wilkes-Barre Pittsburgh **Milwaukee** Denver San Francisco
Birmingham Portland Minneapolis

Canada: The William Kennedy & Sons, Ltd., Owen Sound, Ontario
Exclusive Sales Representatives & Licensed Manufacturers under Falk Patents
Branches: Halifax, Montreal, Toronto, Cobalt, Winnipeg, Vancouver

Falk Herringbone Gears | *Falk Speed Reducers* | *Falk Flexible Couplings*

For the building that *Can't be heated*





Venturafin consists of the following major parts: (1) Copper fin-heater—with five times the radiating efficiency of ordinary iron coils, (2) The famous American Blower Ventura Blower (electrically driven), (3) Air recirculating box.

For the building "too old" to be heated—for the mammoth amphitheatre that simply "can't" be heated—for the temporary structure that wasn't even built to be heated—for the new modern plant with acres of floor space, thousands of windows, high ceilings, and crane housings, there is the Venturafin Method of Unit Heating.

Some of the many benefits of the Venturafin Method of Unit Heating are heat control—the elimination of cold spots—a complete air circuit—heat losses reduced to a minimum—and a more even distribution of heat. It is ideal, too, as an auxiliary unit for cold corners and out of the way places.

Venturafin gives more than five times the efficiency of steam coils, radiators, etc.—has 1/10 the weight—occupies 1/4 the space—costs less than ordinary radiation, and can be employed wherever steam is available. Over 15,000 in use.

Mail the coupon today—no obligation—or ask your heating contractor for the facts on Venturafin.

AMERICAN BLOWER CO., DETROIT
BRANCH OFFICES IN ALL PRINCIPAL CITIES
CANADIAN SIROCCO CO., LTD., WINDSOR, ONT.

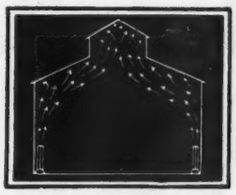
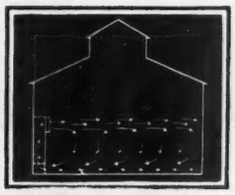


Diagram shows the general tendency of heated air to rise from radiators, steam coils, etc.



This diagram shows an ideal heating system the principle of which is applied in the Venturafin Method.

© A.B.Co. 1927

(632)

American Blower

"Sirocco"

VENTILATING, HEATING, AIR CONDITIONING, DRYING, MECHANICAL DRAFT

Manufacturers of all Types of Air-Handling Equipment — Since 1881

COUPON

AMERICAN BLOWER CO., DETROIT, MICH.

Send details relative to the application of (6) The Venturafin Method of Unit Heating to

*Name*_____

*Address*_____

*City and State*_____

*Type and size of building to be heated*_____

THE OHIO CARBON COMPANY EXTENDS TO YOU BEST WISHES FOR 1928!

Lazy Brushes— mean LOST POWER!

Carbon Brushes can be lazy, indifferent to their work—good enough to "get by." Apparently giving perfect commutation, from all appearances a well made product, the brush may be putting the burden of its service on some part of the machine not intended to carry the load.

On test, the brushes you investigate before buying, may give excellent service and measure up to all of your requirements. But, how well do they function in the long run of practical use?

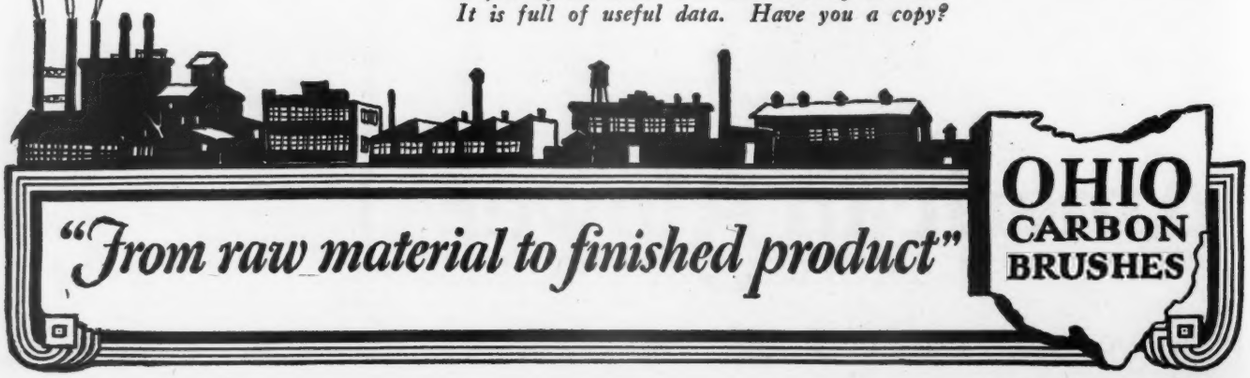
Brushes can be made to meet specifications—or there can be added that "something extra" which costs a little more to produce, but saves the maker and the user any future troubles.

OHIO BRUSHES have that *something extra.* Shunts that are just a little stronger, shunts in which repeated temperature variations will not change the low voltage drop of the connection,—ample and uniform copper coating,—hardness accurately determined—brushes containing the highest grade of graphite or metal for conforming with the operating speed or carrying capacity requirement of specific motors.

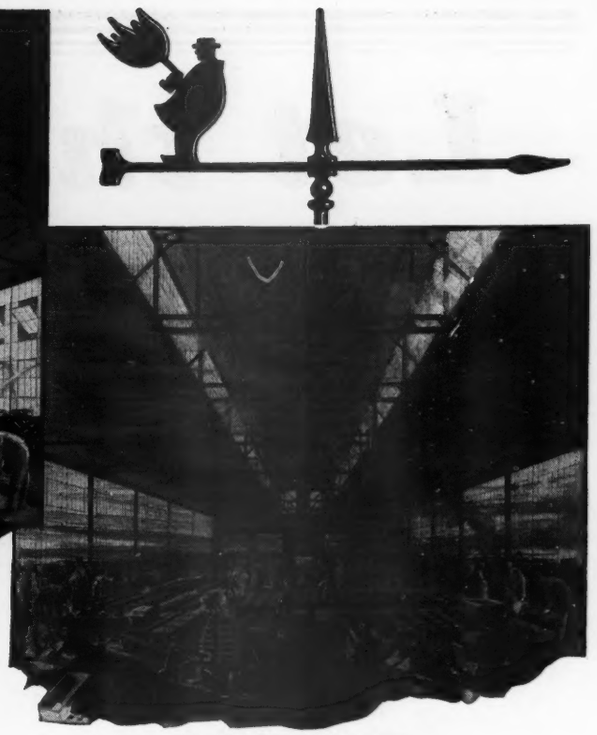
Include Ohio Carbon Brushes in your next replacement order. You will be satisfied with their performance for there's never a lazy one.

THE OHIO CARBON COMPANY
8215 Almira Avenue, CLEVELAND, OHIO

A few of the brushes in our Catalog No. 16.
It is full of useful data. Have you a copy?



Sidewall windows open on both sides.
Monitor windows open on leeward side.



Sidewall windows closed. Monitor windows open on windward side.

How do open windows affect ventilation?

What is the measure of the air which will flow in and out of a building due to the buoyancy of the warmer inside air?

How do size and location of window openings affect possible air changes?

Is the direction of the prevailing wind a factor in natural ventilation?

Under what conditions is the effective flow of air in and out of a building assisted by the motive force of the wind? When is it hindered?

When you are making plans for new buildings—in advance of construction—these questions and many others deserve your serious consideration.

As a result of many experiments with models and tests in actual industrial buildings, our Department of Engineering Research has developed methods by means of which just such questions can be answered with considerable accuracy. By filling out the blank below you can have the benefit of this research work—without obligation.

Ask

Fenestra

DETROIT STEEL PRODUCTS COMPANY · 2230 East Grand Boulevard · DETROIT, MICH.

What can you tell me about the different methods of ventilating the building described below?

Type of building contemplated: Single Story ..... Multi-story .....

To be used for ..... Length ..... Width ..... Height .....

Note: If possible, send tentative plans, elevations, sections or sketches showing size and location of all proposed windows with sill heights, together with any additional information which would have a bearing upon the design of the structure to be erected.

Name of Company ..... Your Name .....

Address ..... City ..... State .....

Let these facts sink in!

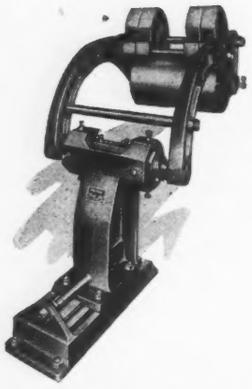
1. The Pulmax Drive has no harmful effect whatever on any first quality, pliable waterproof leather belt. We can prove this to you as we have to hundreds of Pulmax users.

2. The Pulmax Drive is more efficient, economical, dependable, and inexpensive to operate and maintain than any other drive.

Every motor you put in is an opportunity for a Pulmax Drive.

Ask us to prove it.

BIRD MACHINE COMPANY
South Walpole, Massachusetts



There is a standard Pulmax Drive for all widths of belt covering drives from 1 to 1500 H.P.

BOSTON
Bird Machine Company
179 Lincoln Street

NEW YORK
The Power Transmission Co.
173 Lafayette Street

CHICAGO
Chicago Belting Co.
113 N. Green St.

CLEVELAND
Cleveland Tool & Supply Co.
1427 West Sixth St.

NEW HAVEN
The Arthur C. Morse Co.
152 Temple St.

ST. LOUIS
The Teuscher Pulley & Belting Co.
801 No. Second St.

Send for free copy of this up-to-the-minute analysis of transmission. You'll find it valuable and useful.

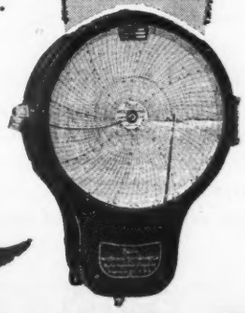
Pulmax Drive

1470

DOLLARS TO DOUGHNUTS !

In a small room in the city of Rochester, more than 75 years ago, there began a business specializing in the manufacture of precision thermometers. And, by adhering strictly to this fundamental principal of specialization, in unfailing accuracy, the Taylor Instrument Company has developed, through scientific research and study, into an institution of highly specialized manufacturing units, anticipating, as it has, every need of industry, the professions, the arts, and the home for indicating, recording, and controlling temperature and pressure instruments.

This vast institution offers to industry 8,000 styles of *Tycos* Instruments—each designed to do a definite job, each carrying with it the unqualified guarantee of the Taylor Instrument Companies for reliability and precision.



Taylor Instrument Companies
Rochester, N. Y., U. S. A.
CANADIAN PLANT, *TYCOS* BUILDING, TORONTO
Manufacturing Distributors in Great Britain:
Short & Mason, Ltd., London.

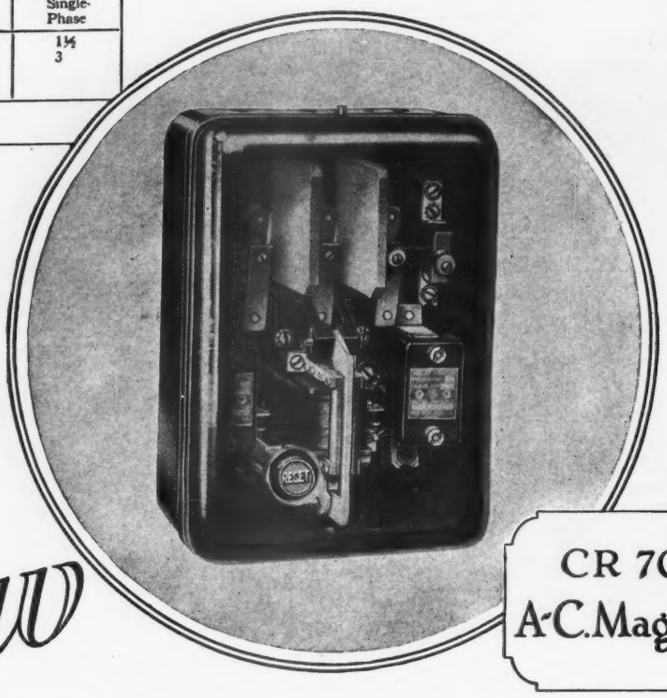
Tycos
Temperature Instruments

INDICATING—RECORDING—CONTROLLING

Tycos THE SIXTH SENSE OF INDUSTRY

RATINGS		
Volts	Squirrel-Cage or Slip-Ring	Single-Phase
110	3	1½
220	5	3
440	7½	
550/600	7½	

Switch can be used with push-button, thermostat, pressure governor, float switch, etc.



CR 7006-D26
A-C Magnetic Switch

A New Unbeatable Combination of Size · Rating · Price

The CR7006 line of magnetic switches has always been the most popular in the industry. The "D26" is the newest—and smallest—of this famous family.

Ask your nearest G-E office to show you the "D26" as soon as possible—for nothing will be so convincing as an inspection. Notice:

The neat, uncrowded, accessible arrangement of parts—all finished in black and silver, and enclosed in a handsome drawn-shell case.

The small size—6¾ in. wide, 5 in. deep, 9 in. high.

The rating—well able to throw a 7½-h.p., 440- or 550-volt motor across the line.

The contactor—double break; strong; fast-moving; operated by a high-speed solenoid; contacts of silver—all combining to give a very high interrupting capacity.

The overload protection—two simple, accurate, hand-reset relays with interchangeable heaters for interchange of ratings.

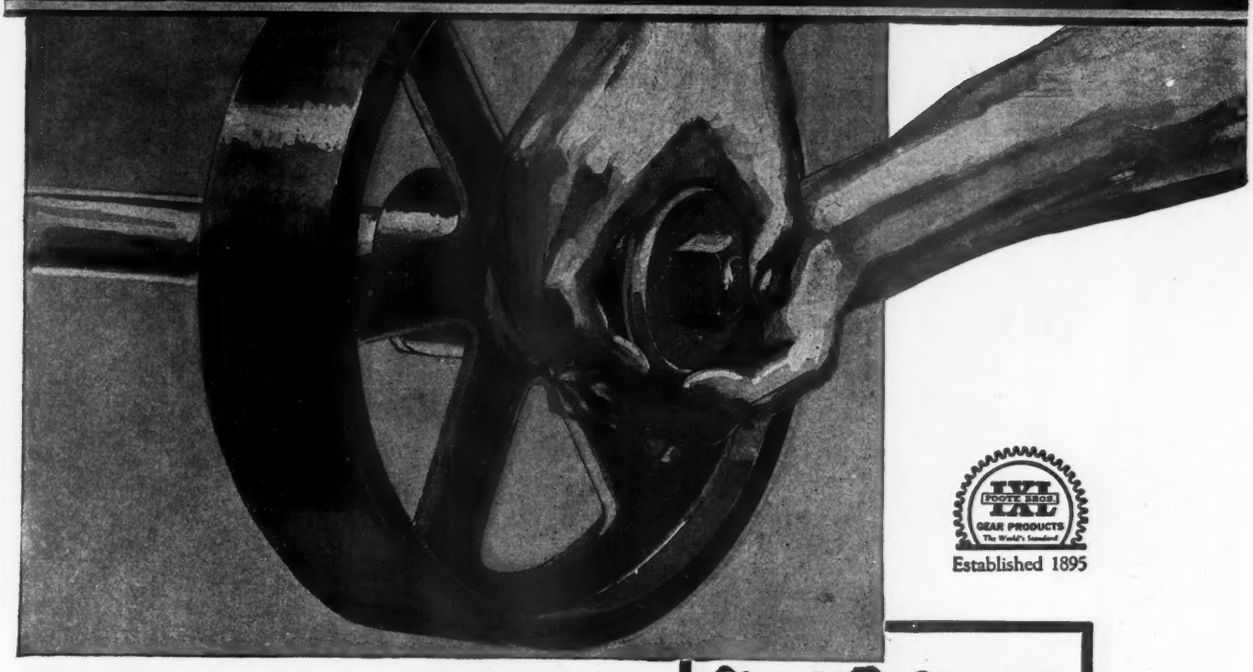
The price—well below any similar combination of size, rating, and appearance.

301-23

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

you wouldn't grasp a wheel by the hub to turn it!



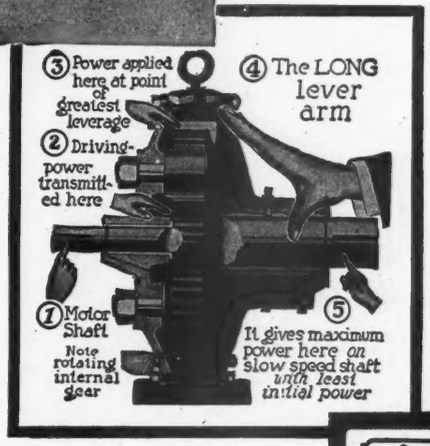
Established 1895

Of Course You Would Grasp the Rim---

because you get there, the greatest leverage and greatest effect in proportion to the power applied.

That in a nut shell, is the patented Long Lever Arm principle of the IXL Spur Reducer—assuring greatest torque delivered to slow speed shaft — and, with a given load — the smallest load on the gear teeth.

See the illustration at the right for graphic description of this principle.


3 Power applied here at point of greatest leverage
4 The LONG lever arm
2 Driving-power transmitted here
1 Motor Shaft
Note rotating internal gear
5
It gives maximum power here on slow speed shaft with least initial power

A copy of Report by Benj. Schenker, M. E., Consulting Engineer, on Speed Reducers, will be mailed on request, also our 79 page Speed Reducer book full of invaluable data. Just Clip the Coupon.

Send for the IXL Speed Reducer Book

R. 197

FOOTE BROS. GEAR & MACHINE CO.
236-246 N. Curtis St.
CHICAGO, ILL.

Please send without obligation a copy of the Foote IXL Speed Reducer Book and Schenker's Report.

Signed_____

Address_____

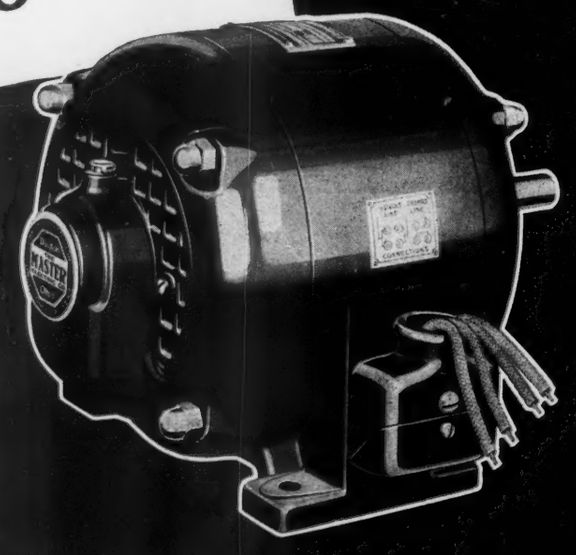
FOOTE BROS. GEAR & MACHINE CO.

236 No. Curtis St., Chicago

Sales Offices in All Principal Cities, U. S. A. and Canada

Not a single kick

Replies Received ~~63	QUALITY	SERVICE
Excellent ~~	32	30
Good ~~~~	26	27
Fair ~~~~	5	6
Poor ~~~	0	0



WE recently sent out a questionnaire to a few of our customers picked at random. It gave them an opportunity of expressing their opinion of Master quality and service. The replies came in as shown above, including certain valuable suggestions upon which to base further refinement, and — *there was not a single kick.*

There's nothing to kick about in Master quality or Master service.

THE MASTER ELECTRIC COMPANY, DAYTON, OHIO

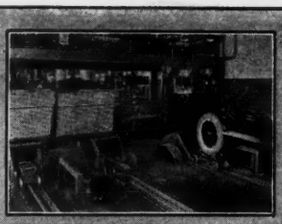
STOCKS CARRIED IN PRINCIPAL CITIES

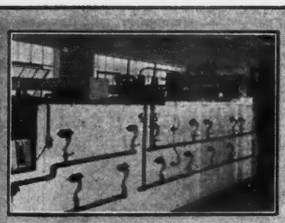
MASTER GUARANTEED MOTORS

⅛ TO 7½ H.P.

Dayton THE MASTER ELECTRIC CO. Ohio

Less than 40°


Automobile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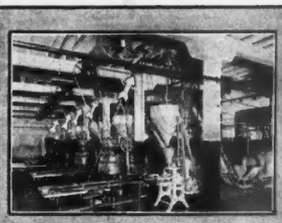
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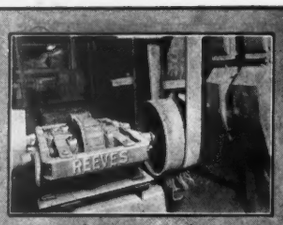
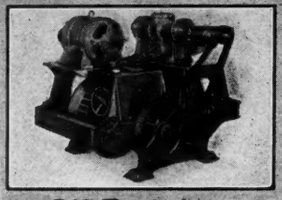


Cement

Industry Comes to Reeves for Accurate Speed Control

The REEVES Transmission represents the *only* method which gives absolute speed flexibility. When a machine is REEVES-equipped, you are the complete master of its speed. You can get instantly *any* speed you desire between fastest and slowest, even to the smallest fraction of a revolution. Inexpensive and easy to install. Simple to operate. Accurate and dependable, *always.*

Write for facts about REEVES ADVANTAGES in your own industry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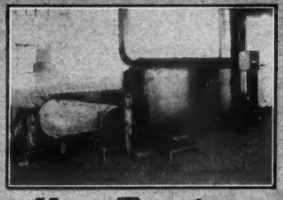
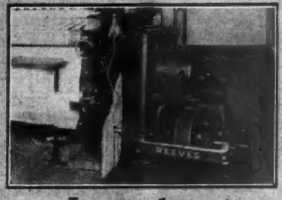
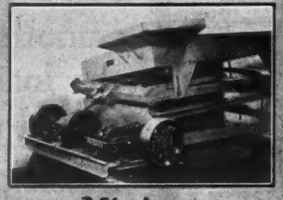

Heat Treating



Laundry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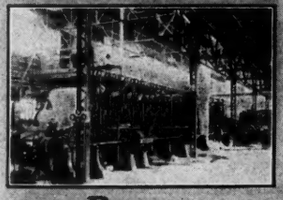
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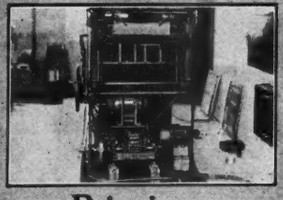
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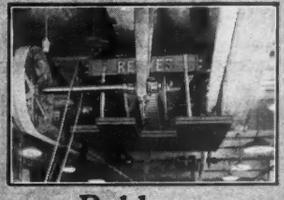
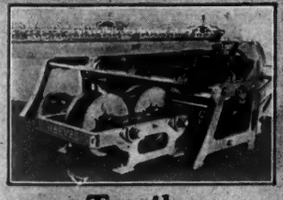

Rubber

Stoker


Textile

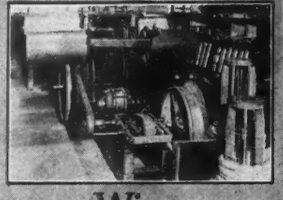
REEVES

Variable Speed Transmission

REEVES PULLEY COMPANY

Established 1887 Columbus, Indiana

Send for catalog E-66. Write your name and address in the lower margin—tear out and mail


Wire

ANY SPEED ON ANY MACHINE AT ANY TIME

no straining

safely

-quietly-

and quietly

saves floors

EASY going is the load that rides on Bassicks—

No more jolting—jumping or stalling. No more screeching casters — or grunting trucks — for Bassicks roll easily — turn easily — ride smoothly — and deliver the load quickly — safely —and on schedule.

Bassicks work for the management — and "team" with the worker—always.

-easy-

-saves floors—

no straining—easy roll

-quietly-

How easily it rolls on Bassicks

BASSICKS
Harvard Steel Ball-Bearing Truck Casters

Heavy gauge steel construction. Sturdy ribbed iron wheels. Embossed top plate, reinforced by independent ball cup—gives double thickness of metal and double strength at vital points.

Lapped ball bearings. Specially annealed, extra heavy king pin.

Spanner bushing, riveted solid between forks of horn protects axle, strengthens horn, prevents its bending inward under weight and binding wheel; gives larger bearing surface for wheel with resultant longer life. (Bulletin No. 104-F on request.)

Bassick Reg. U. S. Pat. Off. **Casters**

The BASSICK COMPANY
(A Division of Stewart Warner)
BRIDGEPORT, CONN.

For thirty-one years the leading makers of Better Casters for home, office, hotel, hospital, warehouse and factory.

Noark

There is no advantage in using cheap fuses to guard against destructive overloads. The cost of renewing even a simple circuit — to say nothing of the expense of rewinding the armature of a motor — is always far greater than anv difference in price of a fuse.

Look for the "Un. Lab. Inspected" label on every fuse you buy. It is your first insurance of a good fuse.

But if you would make assurance doubly sure and know beyond the shadow of a doubt that every sentinel you set to guard your electrical installations will not fail in point of alertness and dependability, see that the name

NOARK

too, is on everv fuse you buy.

Noark fuses, ferrule or knife blade types, renewable or non-renewable, indicating or non-indicating, all are made to

"Blow on the Dot"

and—when used according to their indicated capacities—it is physically impossible for them to fail to do their duty.

COLT'S PATENT FIRE ARMS MFG. CO.
Electrical Division
HARTFORD, CONN. U. S. A.
NEW YORK~BOSTON~CHICAGO~SAN FRANCISCO

33-F-10

Every Light a Controllable Unit

with the

Levolier

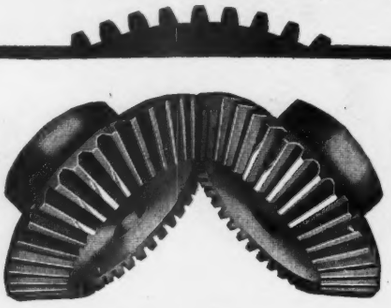
Fixture Switch

The Levolier Fixture Switch allows individual control of every lighting unit. It is a real economy—cuts out the added expense of lights needlessly burning. With this, the smallest 6-ampere switch ever made, it is possible to retain light only where it is most needed and all other units switched off.

The ease and economy of installation together with the great saving in eliminating extra lengths of pipe and conduit, extra switch boxes and wall connections, make this switch a very desirable one for all types of installations.

Your Jobber Can Supply You

McGILL MANUFACTURING CO.
Electrical Specialties of Quality
ESTABLISHED 1905
VALPARAISO INDIANA



GRANT EQUIPMENT
for Cutting Your Gears

We offer and deliver the utmost in gear cutting service. A background of 50 years of unbroken success has created high standards. Our equipment is modern—and there is enough of it.

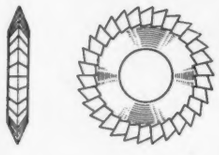
Every possible requirement—gears in all sizes from ¼ inch to 72 inches on all types and materials is a sizable guarantee.

GRANT GEAR WORKS

B and SECOND STS., BOSTON, MASS.

HULLHORST

"V" Mica Cutters



"V" mica cutters are now produced in our factory, in any diameter from 7/16 inch up, with 40, 50 or 60 degree cutting angles.

The Hullhorst special manufacturing processes, and special alloy steel, give our "V" cutters precision accuracy and durability—the same as our "U" type cutters which have proved their superior quality over a period of years.

Your inquiries are solicited

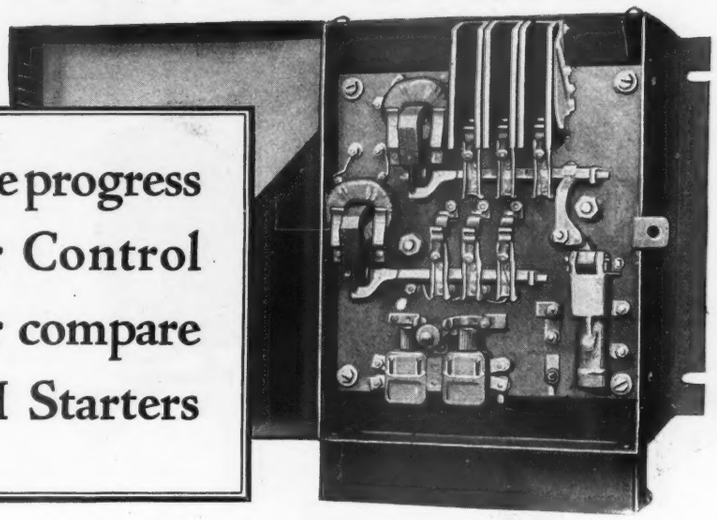
The Hullhorst Micro Tool Co.

Manufacturers of mica undercutting machines and mica cutters

3242D Monroe Street, Toledo, Ohio

For You Men Who Want Facts

To determine the progress in A.C. Motor Control for the last year compare these new C-H Starters



The new C-H Primary Resistor Starter (Bul. 9605) is illustrated. More than a score of features merit your consideration. Write for full information on all new A.C. Starters.

THE new C-H Automatic Starters were designed "under fire". Years of service were crowded into weeks of merciless testing. As failures occurred, part after part was redesigned, retested, redesigned and again retested until the standard *of millions of operations* was achieved.

Millions of operations—such Motor Control service your plant, most likely, will never demand—but the inbuilt dependability and slow depreciation the C-H standard insures, mean big savings in operating and maintenance charges.

Specify Cutler-Hammer for your very next A.C. Automatic Starter installation. Check over the features. Watch it in service. You, too, will say "Nothing else but C-H after this!"

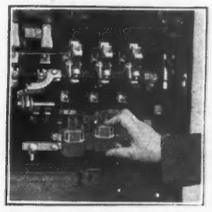
The CUTLER-HAMMER Mfg. Co.

Pioneer Manufacturers of Electric Control Apparatus

1219 St. Paul Avenue

MILWAUKEE, WISCONSIN

Check these exclusive features!

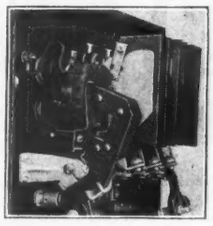


1 *Thermal Overload Protection. Cuts motor from line only when heating of motor windings becomes dangerous. Easily reset from outside of case.*

2 *Overload relay easily adjustable to insure maximum output from motor without danger to windings.*

3 *Thermal Overload Relays easily and quickly reset from outside of starter case.*

4 *Double pull solenoid type magnet. Quick, powerful, positive pull insures full roll-and-rub contact action. Cool operation of contacts and freedom from pitting assures long life.*

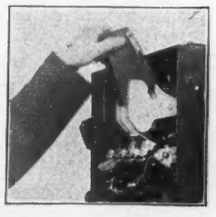


5 *Magnet coils easily demountable. Saves valuable time in replacing coils injured by abuse or accident.*

6 *Hardened and ground steel bearings used for switch mechanism. Adjustable to compensate for wear through years of steady service.*

7 *Every starter part designed for quick replacement. This is most valuable service insurance—constant protection against shut-downs, even in the face of abuse to the starter.*

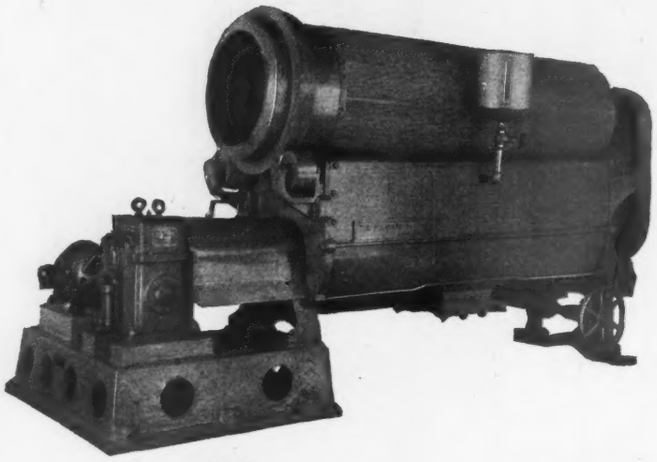
8 *Chimney type arc shields and heavy blow-out coils quickly carry arc away from contacts, greatly increasing their life. Note simple removal of arc shields.*



CUTLER C-H HAMMER

Industrial Efficiency Depends on Electrical Control

DRIVE IT WITH GEARS



The makers of this sand mixer found it to their advantage to use Horsburgh & Scott worm gear speed reducer drives. Delivering a smooth flow of power year after year in sand and grit requires a sturdy, well made reducer. It is in drives where the going is hardest that the real built-in quality of Horsburgh & Scott reducers is apparent.

Send for bulletins describing these reducers in detail

The Horsburgh & Scott Co.

5000 Hamilton Ave. *"Gear Makers Since '89"* Cleveland, U. S. A.

Gears for Every Industrial Purpose—Worm—Bevel—Herringbone—Spur—Spiral—Hardened Heat Treated Gears—Non-Metallic Gears and Pinions

TRADE Dolph's MARK

Extra high grade black finishing, air-drying insulating varnish
Applied by brush, spray or dipping
Absolutely oil- and water-proof
Highly resistant to acids and alkalis
Solvent, 188 proof No. 5 completely denatured alcohol
No nitro-cellulose
Highest degree of elasticity
Used as a finish or as a maintenance

ELECTRIC LACQUER
AIR DRYING BLACK INSULATING VARNISH

Send for a trial gallon of Electric Lacquer at special price of $3.25 F. O. B. YOUR SHOP. Make the test. YOUR MONEY RETURNED IF NOT ENTIRELY SATISFIED.

Other Dolph Produts
Black Baking Chinalak
Absolutely oil- and water-proof—The ideal Baking Varnish
Red Oil-Proof Enamel—For the Exposed Ends of Commutators
The John C. Dolph Co., *Specialists in Insulation,* Newark, New Jersey

EARLE GEARS
Snappy action on Rush Orders

Many of our orders are rush orders.

We do our darndest on priority orders because we realize what a serious matter it is to have a machine, department, or entire factory tied up.

If your production is held up because of a broken gear, wire us your order for the replacing one.

The Earle Gear & Machine Co.
4707-15 Stenton Ave., Philadelphia, Pa.
New England Office, 110 State St., Boston, Mass.
95 Liberty St., New York City

"We are also manufacturers of Lea-Simplex COLD METAL SAWS and OPERATING MACHINERY for movable bridges, locks, gates, dredges, etc."

BUY dependability, long life and trouble-free operating service. Buy MARING Magnet Wire!

It is deliberately designed to stand up under the most adverse conditions. Buy manufacturing-profits insurance! Specify "MARING" for your magnet wire requirements.

The MARING Process insures you a magnet wire faithful in its performance throughout the years.

MARING Sales Engineers are ready at our Nine Branch Offices to co-operate with your plant men or consulting engineers on the use and application of magnet wire. This service entails no expense or obligation on your part.

Send for Free Catalog.

MARING WIRE COMPANY
MUSKEGON, MICH., U. S. A.

MARING Magnet Wire

ON THE SPOT!

AN ACCIDENT—

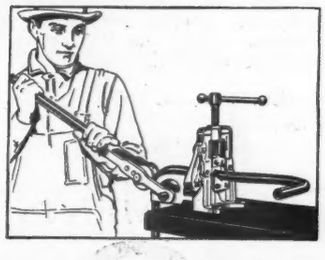
in the plant will require installation of temporary electrical service quickly, and later replacement of the damaged lines.

"JIFFY" Tools play a large part in such instances because they enable the workman to accomplish the maximum labor in the least possible time, with the least effort and EXPENSE.

Jiffy
Adjustable
CUTTER

Cuts holes in steel boxes, walls, switchboard panels, etc., any diameter from ¾-in. to 6-in., quickly, easily and neatly. It is standard equipment in thousands of shops. Absolutely guaranteed to be satisfactory.

Order on 10-day FREE TRIAL



Jiffy PIPE BENDER VISE

May be used as a Vise for conduit up to 2-in. and bends ½-in. and ¾-in. pipe quickly, easily and ACCURATELY. Doesn't kink, split or flatten the pipe, even on a 2-in. radius bend. Makes a 4-in. drop without injuring the threads. Saves hours of time and labor and pays for itself quickly.

10 day *free trial.*

"The Jiffy Line" Bulletin describes other valuable tools of the "JIFFY" Line. Sent on request.

MAIL COUPON TODAY

PAUL W. KOCH & COMPANY
33 South Wells St., CHICAGO

- ☐ Send JIFFY Cutter on 10 day free trial.
- ☐ Send JIFFY Pipe Bender Vise on 10 day free trial.
- ☐ Send JIFFY LINE Bulletin.

Name.....
Firm.....
Street.....
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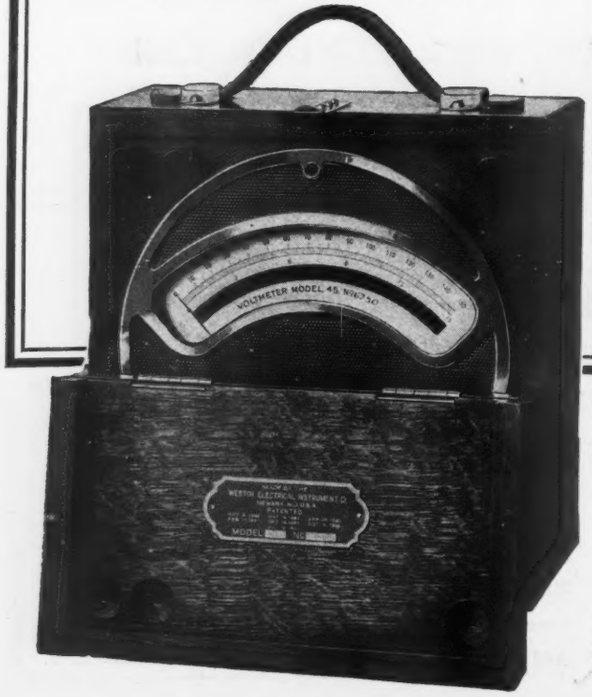
In Life-long Partnership with "WESTONS"

WESTON has been far more than a mere *supplier* to the Electric Power Industry during the past forty years. By invitation, we have been privileged to sit in its inner councils, developing the necessary instruments to serve its needs, step by step, throughout the *entire period* of its history. The industry in all its branches—laboratory, manufacturing and power equipment operation—has brought its various testing problems to us to be solved. Our mutual relations have been more like a partnership, in which Weston's responsibility has ever been *extreme accuracy and reliability of the test result.* This explains why the second and third generations of engineers are reluctant to experiment with other instruments.

Model 45 D. C. Portables are recommended for general industrial testing. They employ the same principles of design as the original Westons—famous for forty years. Accuracy, ½ of one per cent. Thoroughly shielded and built into a strong wooden carrying box. Knife-edge pointers and mirror scales. Made as Voltmeters, Ammeters, Millivoltmeters and Milliammeters.

WESTON ELECTRICAL INSTRUMENT CORP.
136 Weston Avenue, Newark, N. J.

Weston
PIONEERS SINCE 1888
INSTRUMENTS



7½ kva. Single Phase Lighting Transformer

SORGEL Air-Cooled Transformers

Prompt deliveries on standard types in sizes ¼ to 50 K.V.A.

Sorgel Air-Cooled Transformers are neat and compact. All self-contained in a single unit. They require no additional conduit cutting, and fit right into the cabinet. They are simple to install, and cost less over a period of years.

Transformers designed for Special Applications.

Many desirable industrial applications for these transformers, such as:—
110 volt lighting from 550-440-220 volt.
Power changes—2 to 3 phase, 550 or 440 volt to 220 volt, etc.
Heat treating furnaces.
Series lighting systems.
Voltage boosters or adjusters.
Electric Welding—and many other special apparatus.

Send for our Bulletin No. 1027.

Sorgel Electric Company

91 W. WATER ST., MILWAUKEE, WIS.

NEW and IMPROVED

TRICO
REG. U. S. PAT. OFF.

"Famous For Performance"

RENEWABLE FUSES

Ferrule type—Only 2 parts and the TRICO Powder-Packed Renewal Element.

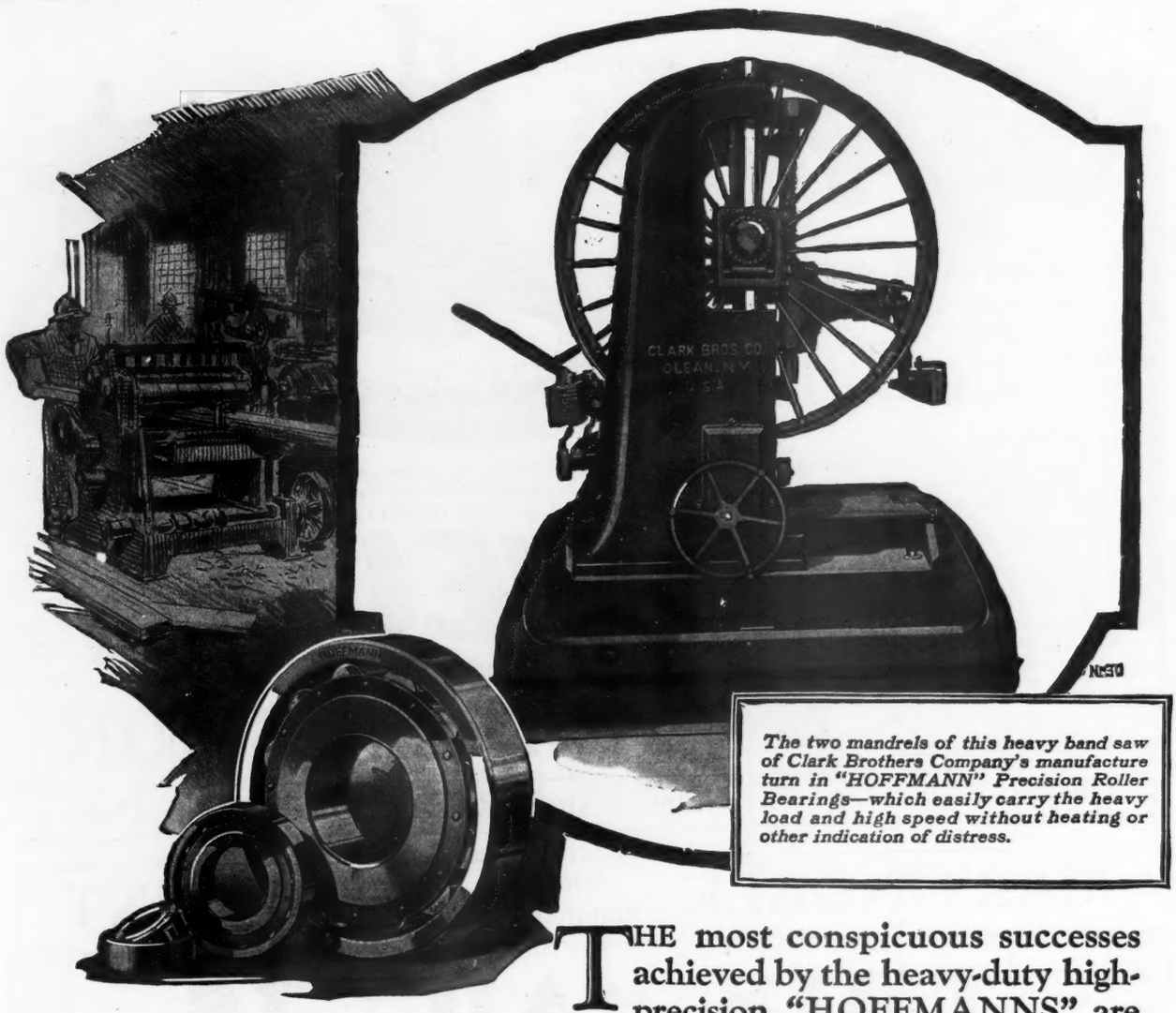
Knife Blade type—Only 3 parts and the TRICO Powder-Packed Renewal Element.

No Small Parts—Durable Construction
They're "POWDER-PACKED"

A request, on your firm's letterhead, will bring free samples—no obligation.

TRICO FUSE MFG. CO.

Makers of High Grade Fuses since 1917
1002 McKinley Ave., Milwaukee, Wis.



The two mandrels of this heavy band saw of Clark Brothers Company's manufacture turn in "HOFFMANN" Precision Roller Bearings—which easily carry the heavy load and high speed without heating or other indication of distress.

THE most conspicuous successes achieved by the heavy-duty high-precision "HOFFMANNS" are those many cases where they are standing up successfully under conditions which caused the failure of all bearings previously used. This, obviously, means an exceptional factor of safety available, in the "HOFFMANN," for service less arduous but still in the heavy-load class.

Let us send Catalog 904.

NORMA-HOFFMANN BEARINGS CORPORATION
STAMFORD, CONN. · · U. S. A.

NB-870

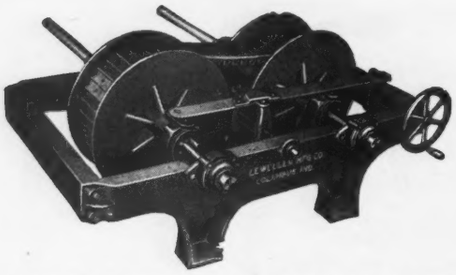
CHICAGO POWER SHOW FEB. 14-18

"NORMA" PRECISION BALL BEARINGS

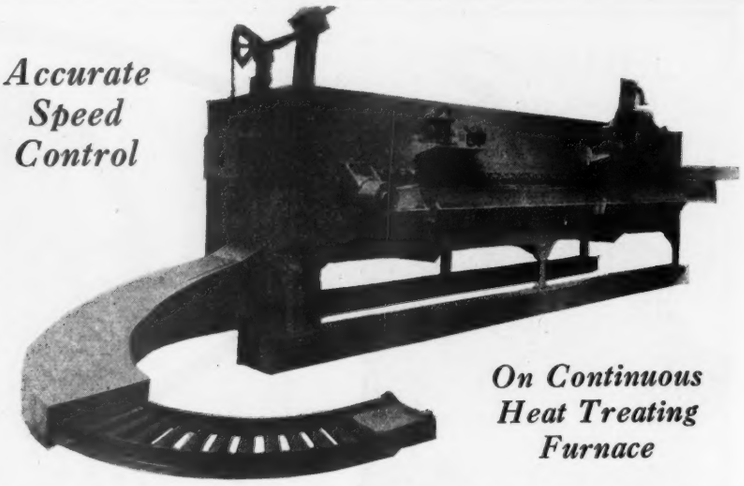
In both open and closed types and in all standard sizes offer, for the lighter bearing duties, the obvious advantages of high-precision quality.

Catalog 905 describes them.

"HOFFMANN" PRECISION ROLLER BEARINGS



Accurate Speed Control



On Continuous Heat Treating Furnace

LEWELLEN TRANSMISSION UNIT

Speed control is an absolute necessity on this Metal Equipment Company Electric Continuous roller hearth furnace, used in the treatment of automobile springs at the

L. A. Young Industries, Inc.

plant in Detroit.

With a LEWELLEN variable speed transmission, speed changes from 7 minutes to 35 minutes are obtained. A speed indicator indicates the relative speeds, enabling the operator to duplicate exact heating conditions on various material treated.

LEWELLEN Transmissions do not jerk. Speeds can be varied from slow to fast and fast to slow gradually as required. Write for the LEWELLEN catalog.

There are thousands of applications of LEWELLEN Variable Speed Transmissions. Every manufacturing process needs this flexible speed control.

LEWELLEN *Variable Speed* TRANSMISSION

LEWELLEN MFG. CO., 1300—10th STREET, COLUMBUS, IND.

MARTINDALE Motor Maintenance EQUIPMENT

THIS "AD" IS TOO SMALL!

. . . to tell you about ALL of the GOOD POINTS of the **Universal Full-Reaction Brush Holder**

. . . . *Some of them are* . . . .

INCREASES—Life of Brush; Life of Commutator; Commutating Efficiency.

PREVENTS—Brushes from moving sideways on commutators; Brushes from shifting or moving in holder due to side oscillation of armature; Brushes from wearing unevenly.

MARTINDALE ELECTRIC CO.
1252 W. 4th St., Cleveland, Ohio

Send me your Bulletin on Universal Brush Holders:

Name and Title .....

Company .....

Street .....

City ..... State 12-27

MARTINDALE Motor Maintenance EQUIPMENT

Announcing

A change in name

On and after January 1st, 1928,

The AB Products Division of

The

National Screw & Manufacturing Co.

will be known as

The Abolite Reflector Co.

Abolite Enameled Steel Reflectors and Gyrofans, products of this division for many years, will be made at the same plant and by the same organization as here-to-fore, the change being in name only.

Kindly co-operate with us in addressing all correspondence pertaining to Abolites and Gyrofans to

The Abolite Reflector Co.
2500 E. 75th St.,
Cleveland, Ohio,
beginning January 1st, 1928

AB Products Division

The National Screw & Manufacturing Co.

2500 E. 75th Street
CLEVELAND, OHIO

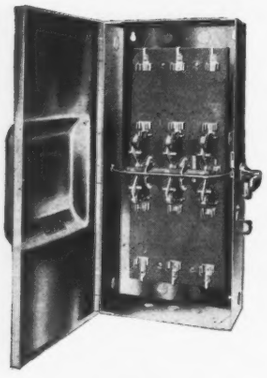
SEVERE arcing is dangerous.

It tends to impair switch jaw posts and blades; flash-overs, likewise, may result in physical injury to the operator.

The Trumbull "Snuf Arc" has two insulating barriers which confine the arc to a narrow space, preventing it from flashing over between poles or from one pole to the box. The two barriers are joined by an asbestos composition which intercepts the path of the arc between the jaw posts and the blade.

The asbestos composition in its passage over the jaw post lengthens the path through which the arc must travel and also tends to snuff the arc by cooling the copper vapor. The barriers confine the arc in such a way that it can cause no damage even under severe overload. Snuff the arc and save the switch.

"Snuf Arc" Switches



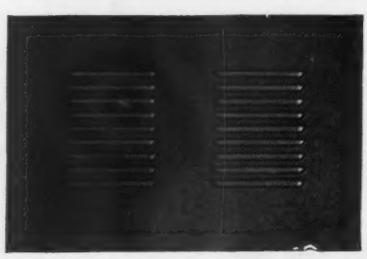
"They Break the Arc"

The switch shown at the left, is a three-pole, 600 v., A. C., 60 amp. Double Throw Safety Switch. The adaption of the "Snuf-Arc" to double throw switches is a recent accomplishment.

"Circleteed is Guaranteed"

The Trumbull Electric Mfg. Co.
Plainville, Conn.

New York Chicago San Francisco Boston Philadelphia Atlanta Ludlow, Ky.



STAMPED LOUVRES

For general purposes. Shutter operated LOUVRES for POWER HOUSES and REFINERIES

We build them to your specifications. Send pencil sketch or blue print.

THE BREESE BROS. CO., Cincinnati, Ohio

FABRICATORS OF

Steel, Iron, Brass, Copper, Monel Metal— Requiring Stamping, Forming, Drawing, Blanking, Punching

See Data A. S. M. E. Condensed Catalogue of Mechanical Equipment, McRae-Hendricks and Thomas Catalogues.

"CARENCO" BRUSHES

Mr. James Brower of the Milwaukee Sewage Disposal Plant says: "Carenco Brushes have kept the plant running without causing shut downs. The few hair I have left will now remain as my brush worries are over."

Why not let us take your brush problems and solve them?

CARBON ENGINEERING CO., Milwaukee, Wis.

Careful Laboratory Tests show:—

85% Copper Grindings
15% Resurfacer and Carbon Brush Grindings for

IDEAL Commutator Resurfacers

the only stones which can show this high efficiency.

Our 10 day FREE TRIAL offer will convince you.

Ideal Commutator Dresser Co., 1065 Park Ave., Sycamore, Ill.
Gentlemen: Please send me details of your free trial offer.
Name .....
Address .....
City ..... State.....

THIS MILL TURNED DEADLY OVERHEAD INTO DIVIDENDS *with* SKF Hanger Equipment

YOU executives, plant engineers and all other officials interested in fighting high overhead, consider the recent experience of a large Southern textile mill.*

For years, excessive friction from troublesome plain bearing transmission equipment was increasing manufacturing costs and sending overhead skyward. Then, the decision came to install Skayef Self-Aligning Ball Bearing Hangers. As a result, a careful record of actual savings shows that the yearly power consumption was cut $1,900.00, while additional savings in maintenance and lubricant costs bring the total yearly dividend on the amount invested to 49%.

Let Skayef Ball Bearing Hangers help you fight production costs in 1928. A corps of SKF engineers is ready to offer you the benefit of their world-wide experience in friction reduction.

CHICAGO POWER SHOW FEB. 14-18

A certified survey enumerating actual savings in this plant will be forwarded free on request. May we send you a copy?

1927

SKF

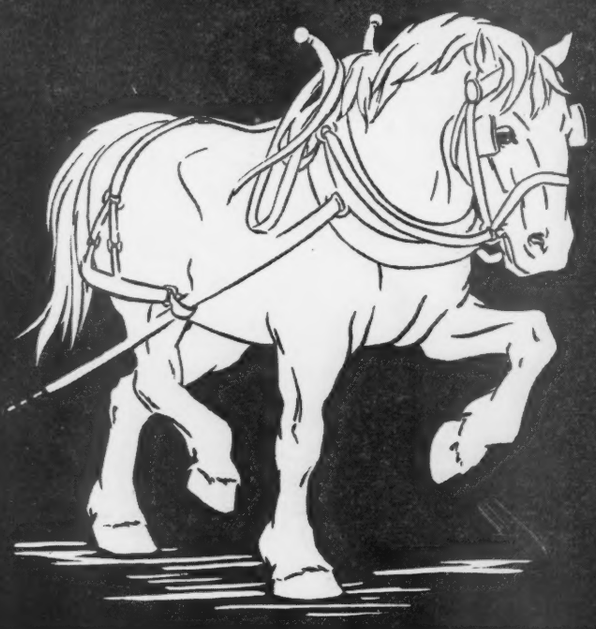
MARKED

Self-Aligning **HANGERS** *Ball Bearing*

SKF INDUSTRIES, INC. ~ S. E. cor. Madison Ave. at 34th St. ~ NEW YORK

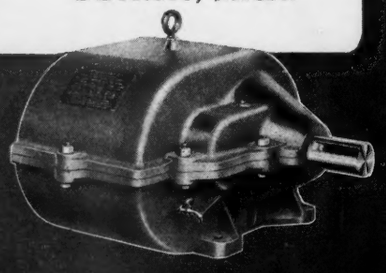
Controlled Speed

is "horsepower saved"



STEPPING down the r.p.m. of standard electric motors to the most satisfactory operating speed for the driven machine—maintaining that same consistent speed hour after hour, day in and day out the year round—*with a power loss that is insignificant,* Palmer-Bee Speed Reducers earn their original cost many times over through the numerous advantages and economies effected.

PALMER-BEE CO.
DETROIT, MICH.



Mathias **KLEIN** & Sons
Established 1857 — Chicago Ill USA

Since 1857

	TACKLES	SAFETY STRAPS
	CLIMBERS	LAG WRENCHES
PLIERS	TOOL BAGS	TREE TRIMMERS
BELTS	WIRE GRIPS	SLEEVE TWISTERS

STOPS RUST!

FLEXIBLE COMPOUND

Stops rust, corrosion and destructive action of acids, gases and fumes.

Used successfully 25 years. Applied like paint

Made in five colors; also white, black, aluminum and clear.

Write for descriptive folder, color card and price.

ATLANTIC DRIER & VARNISH CO.
PHILADELPHIA
Established 1888

UNIVERSAL
FUSE & CIRCUIT TESTER

Tests 100 to 600 Volts A. C. or D. C.

ELECTRICAL MEN

Locate your *shorts* and open circuits, grounds, with a *Universal.* Saves *time,* eliminates *shocks* and *burns.*

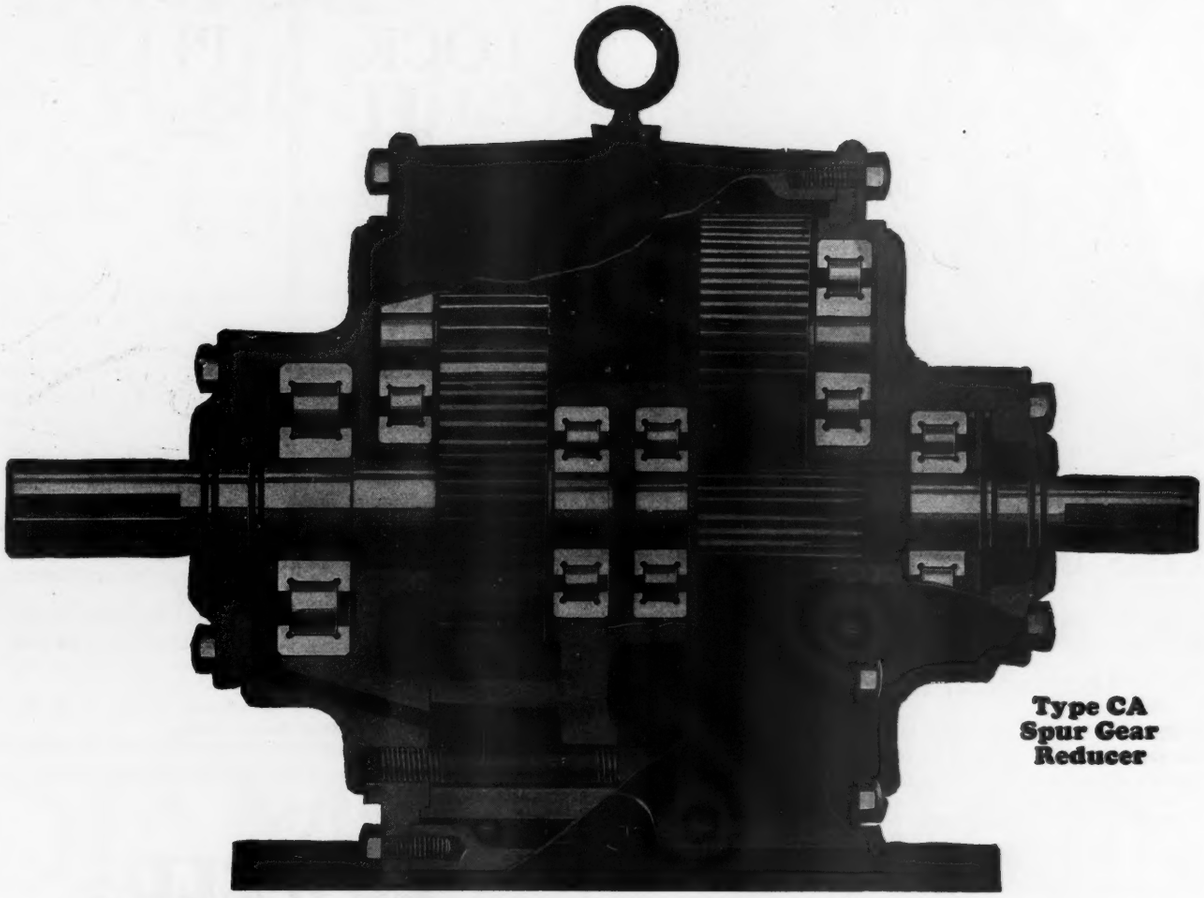
Has stood the test.

Fully guaranteed. Price $5.00. Discounts, ask your Jobber or write us direct.

Electric Tester Mfg. Co.
346 Sherlock Bldg., Portland, Ore.

AD SPEED REDUCERS

with Full Anti-Friction Bearings



Type CA Spur Gear Reducer

Get the Speeds You Want with Least Power Loss!

Because—1 — Full Anti-Friction Bearings
2 — Our famous "Zones of Quiet" accurately-cut Gears
3 — All shafts supported at both ends, hold gear teeth always parallel.

Also 5 other Outstanding Advantages

—The unusually compact design conserves space
—The superior rigidity of these Reducers insures least vibration
—The dust-proof and oil-proof construction insures long service
—The exceptional accessibility saves time
—Maximum possible efficiency

Write us about your Speed Reducing Problems.

AD SPEED REDUCERS

Made in Worm Gear *and* Spur Gear Types

ALBAUGH-DOVER MFG. CO., 2224 Marshall Blvd., Chicago, Ill.

We supply Gears of all kinds— Spur, Bevel, Helical, Worm, Internal, Bakelite and Raw Hide Pinion. Send us your sketches, blue prints or specifications for estimates.

This belt grips pulleys better

(because of its soft finish)

All Schieren Belts have a soft pliable finish that enables them to deliver full power the moment they are put on the pulleys.

If we sent belts to you with their surface jacked and rolled to a hard glaze they would require many hours of "running in." But Schieren Belts are ready to handle their full rated horse-power when they leave our hands.

Look at the surface finish on the belts you buy. Are you paying for power to break-in new belts? The soft desirable finish of the Schieren Belt is yours at no extra cost.

DUXBAK BELTING TRADE MARK

Chas. A. Schieren Company ESTABLISHED 1864

Tanners
Belt Manufacturers

Main Office and Factory
72 FERRY STREET NEW YORK
Branches and Distributors in All Principal Cities

Fixed and Flexible Idlers
On Leather Belt Drives
By ROY C. WOODS, M. E.
COMPLIMENTS OF
Chas. A. Schieren Company
Tanners and Leather Belt Manufacturers

A free booklet for you!

Coupon

Gentlemen:—

Please send me a copy of your free booklet

Name .....

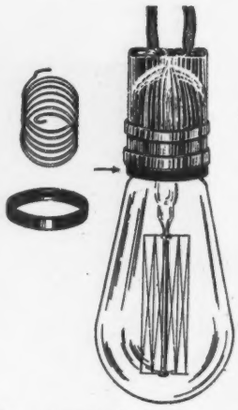
Company .....

City .....

State .....

DUXBAK
WATERPROOF
LEATHER BELTING

REN — LOCK

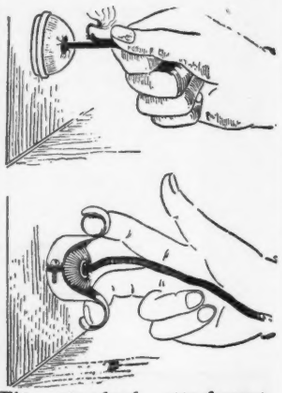


Fits standard lamps and standard brass and porcelain sockets and "Hubbell" weather-proof sockets.

Write for Free Sample and Particulars.

Sold Direct Only.

PULL A PLUG



Fits standard attachment plugs.

No rewiring.

Prevents broken wires, broken plugs, and burnt-out fuses.

Order Through Your Dealer or Direct

Samples, 2 for 25 cents, postpaid

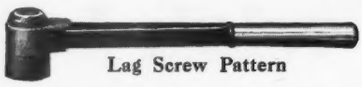
REN MFG. CO.

18 Mt. Vernon St., Winchester, Mass., U. S. A.

Cable Address: Renlock, Boston.

IT'S A LOWELL

The General Purpose Wrench



Lag Screw Pattern

No.	Length of Handle	Average Weight	Size of Opening, Inches	
			Square	Hexagon
1	12"	2½ lbs.	⅜ taper, 1½, ⅝, ¹¹⁄₁₆, ¹³⁄₁₆, ¹⅞, ⅞, ¹⅛, 1 ⅛, 1¼	¹¹⁄₁₆, ¹³⁄₁₆, ⅞, ¹⅛ 1 ⅛, 1¼.
2	16"	4½ lbs.	1, 1 ⅛, 1¼, 1 ⅛, 1⅜, 1 ⅜	1 ⅛, 1¼, 1 ⅛, 1⅝
3	20"	10 lbs.	1, 1 ⅛, 1⅜, 1¼, 1 ⅛	1, 1 ⅛, 1¼, 1 ⅛, 1⅝, ¹³⁄₁₆

Don't let your workmen waste their time with the ordinary wrench.

Give them a REVERSIBLE RATCHET WRENCH with the name LOWELL on it.

It pays now. It will pay in the end.

A Ratchet Wrench for Every Purpose.

LOWELL WRENCH CO.

54 Commercial St., WORCESTER, MASS.

Ask your Hardware Dealer for them or send for Catalogue.

LOOK FOR THE DIAMOND ON THE LINK

Even the Well-Informed Engineer—

WE'VE got to forget a lot if we want to keep up-to-date. We can't afford to let ideas formed ten years ago blind our appreciation of a later—and, frequently, important—development.

For example—if we ever did think of roller chain as a typically slow-speed drive we've got to forget it. We've got to *kill* that association if we're going to make the most of modern Diamond Roller Chain adaptability, and high speed efficiency.

In these days of rapid engineering progress even the well-informed engineer frequently has to scrap a preconceived notion and concentrate on the modern facts.

Today, Diamond high speed Roller Chain will transmit power *at as high speeds as any other type of chain—quietly,* efficiently, smoothly.

In Diamond Roller Chain, improved steels, improved bearing surfaces, better sprocket tooth shapes, greater manufacturing precision have all been worked together into a design the very simplicity of which means added lightness and strength.

Thus it is that The Diamond Chain & Mfg. Co., with the largest plant in the world devoted solely to roller chain manufacture, has developed a chain of 98 to 99% efficiency—smooth, *quiet* and dependable, on speeds as high as 3600 r.p.m.

* * *

"But this can't be the roller chain we've always thought of as a low speed drive!" It most decidedly *isn't.* That's just the point—it's a chain unusually efficient on *high* speeds—unusually economical and dependable—a silent chain you ought to know more about! It is made in multiple strands as well as single.

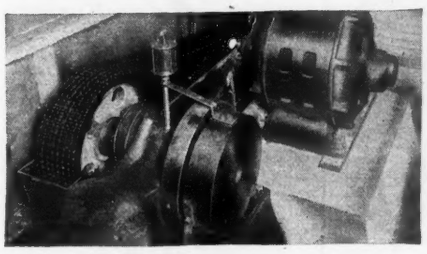
Rolling Surfaces ◇ *Discourage Wear*

DIAMOND CHAIN

ROLLING ~ AT POINTS OF CONTACT

How Vital is Economical Transmission to *Your* Profit?

TRADE MARK
Makers of High Grade Drive Chain Since 1890



A 60 h. p. blower drive using two strands of Diamond high speed triple Roller Chain—another example of the increasing use of this quiet, long lived, low maintenance transmission.

Production is your income—the efficiency of that production measures your profit. Production is dependent on *motion*—the motion of your machinery—machinery dependent for its motion upon motors. Diamond Roller Chain transmits 100% of the speed and 98-99% of the power developed in those motors. That is efficiency.

Investigate this modern Diamond Roller Chain* now—*Tear out the reminder coupon.

The Diamond Chain & Mfg. Co.
Indianapolis, Ind.

You may send your booklet "Rolling the Problems Out of Transmission," to:

Name_____

Address_____ State_____ I.E.

City_____

The DIAMOND CHAIN & MFG. CO., Indianapolis, Ind.

REPRESENTATIVES

CHICAGO—6 N. Mich. Ave.
CLEVELAND—E. 6th and St. Clair Streets
GREENVILLE, S. C.—408 Masonic Temple
PHILADELPHIA—1011 Chestnut Street

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NEW YORK—R. M. Barwise, Inc.
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PHILADELPHIA—Robert L. Latimer & Co.
BUFFALO—Root-Neal Co.
DETROIT—Palmer-Bee Co.
CHICAGO—Cullman Wheel Company.
CINCINNATI—Wirthlin-Mann Co.
BIRMINGHAM—Moore-Handley Hdwe. Co.
NEW ORLEANS—C. T. Patterson Co., Inc.
SAN FRANCISCO—Chain Belt Co.
LOS ANGELES—Chain Belt Company
PORTLAND—Chain Belt Co.
SEATTLE—Chain Belt Co.
CANADA—Canners Machinery, Ltd., Simcoe, Ontario

"C J B" Bearings are the finest ball bearings which years of intimate contact with bearings of every description have taught us how to make.

"C J B" Stands for Quality

"Let us Answer that!"

WHATEVER the bearing problem may be—*let us solve it.* We offer this service without obligation and feel particularly fitted to be of the greatest practical assistance. Our years of familiarity with applications of every description enable us to meet every bearing problem of machine design, operation and maintenance with the most economical solution.

May we help you?

AHLBERG BEARING CO.
321 E. 29th St., Chicago, Ill.

Ahlberg

CJB

"MASTER" BALL BEARING

Rowan A.C. Starting Switch For Squirrel Cage Motors

Completely Oil-Immersed

◈

Remote Control

◈

I.T.E. and Instantaneous Overload Protection

Another Rowan starter for heavy duty starting jobs. Dustite, gastite and weathertite.

The relays are of the magnetic type completely oil-immersed, and afford positive Inverse Time Element protection against Sustained Overloads and Single Phasing. They also operate Instantly on Short Circuit, thus eliminating the need of fuses.

Ask for Bulletin 7375-1

ROWAN CONTROL
THE ROWAN CONTROLLER CO., BALTIMORE, MD.

Trester Transformers

Air Cooled

A complete line in sizes up to 20 K.V.A.

Economical and efficient in operation, meeting all requirements of the code. For use in connection with 2 or 3 wire Lighting Systems; as an integral part of Industrial Equipment; for Testing purposes; Phase changing; Line Drop Compensators; Electric Welding, etc.

***Immediate shipment* can usually be made from stock on Standard Transformers.**

Send for our Bulletin 527

Representatives desired in principal cities and Industrial centers.

TRESTER SERVICE ELECTRIC CO.
55 E. Wells St., Milwaukee, Wis.
"Trester Service Since 1908"

What the Chicago Power Show means to YOU

1. An opportunity to see the latest and most modern power equipment of the foremost manufacturers.
2. A broadening of your education by means of actual comparison.
3. A place to discuss your problems with several recognized experts.
4. A place to study modern methods and processes in power plant operation.
5. An opportunity to investigate low operation costs and standard practice.
6. A place of education for greater usefulness and earning power in your profession.
7. An opportunity to renew old friendships and make new ones.
8. A place to buy for your future needs.

MIDWESTERN ENGINEERING EXPOSITION, Inc.
53 W. Jackson Blvd., CHICAGO, ILL.

Meet with the Masters of Power at the

Chicago Power Show

Coliseum February 14th to 18th

"Gives four times as much wear"

HERE is a typical experience as described in a letter written to us by a user of Magnolia Anti-friction Metal:

"The dust getting into our bearings from our crushing operations made the bearings run quite dry and caused them to melt from the heat, until we used Magnolia Metal. We find that one set of Magnolia bearings gives four times as much wear with less expenditure for oil than any other bearing metal we have ever used."

If Magnolia Metal can give such results in these severe operating conditions, think how it will improve the bearing service in your own plant.

Order a quantity of Magnolia Metal from your dealer and try it in your most troublesome bearings. You will soon see the advantages of standardizing on it.

This handy bearing information book

FREE

if you return the coupon

96 pages of practical data, suggestions and instructions. Shows how to select bearing metals, how to melt, pour and finish linings. A valuable reference book based on 41 years of experience.

MAGNOLIA ANTI-FRICTION METAL

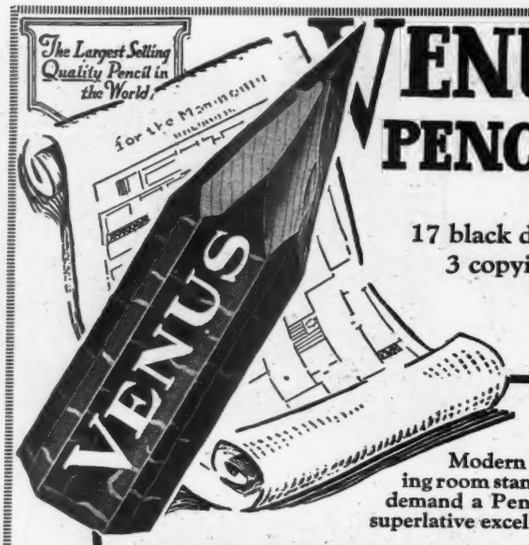
TRADE MARK

In the Metal Line Specify Magnolia Products

The Magnolia Metal Co., 75 West St., New York.
Please send me free Magnolia Bearing Book.

Name .....

Address .....
I.E. 12-27



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17 black degrees
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Modern drafting room standards demand a Pencil of superlative excellence.

VENUS PENCILS are matchless for smoothness of lead; uniformity of grading and durability of point.

UNIQUE THIN LEAD COLORED PENCILS

Make fine lines for figuring, checking, sketching, blueprints, etc.

Blue	Purple	Pink
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$1.00 per doz.

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For bold heavy lines 6B-5B-4B-3B
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Plain Ends—per doz. $1.00
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At Stationers and Stores throughout the World

American Lead Pencil Co.
224 Fifth Ave., New York

Production Falling?

Check Your Commutators

When your production curve shows a tendency to fall below normal. And when there is no apparent cause for the drop, its a safe guess that the trouble lies in your electrical equipment.

Aurand Jr. Commutator Slotter

Commutators and collector rings may have flat spots or may be out of true. Surfaces may be rough and worn. Commutators may need undercutting or slots may require filling with cement. Any one of these defects will reduce the efficiency of your motors or generators—and directly be responsible for loss of production and power waste.

Acme Commutator Stone

Green equipment listed below will help raise your production and keep it high. Prices or other information furnished on request.

For Your Motors and Generators

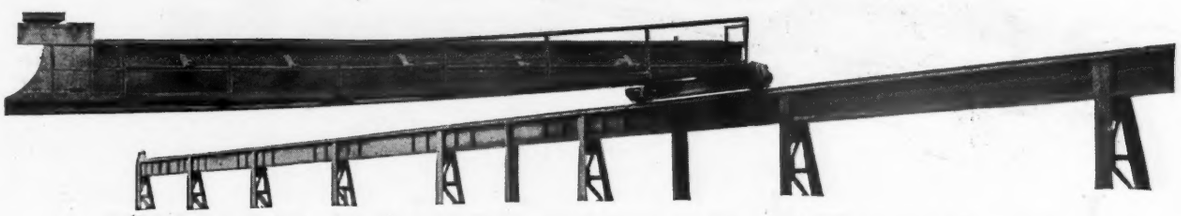
Commutator Stones	Grinding Tools
Commutator Slotters	Air Gap Gauges
Portable Blowers	Armature Washing Fluid
Commutator Cement	Insulation Scrapers

Address Dept. "I"

GREEN EQUIPMENT CORP.

Monadnock Block Chicago, Ill.

A large St. Louis steel mill changed to "Tool Steel" crane equipment —



A LARGE steel mill in St. Louis previously used high carbon rolled steel wheels, which machined, cost them $40.00 each.

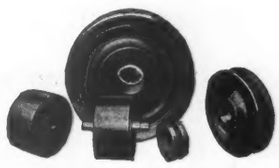
They replaced them with "Tool Steel" wheels and increased the life to 12 times that they had averaged from untreated wheels.

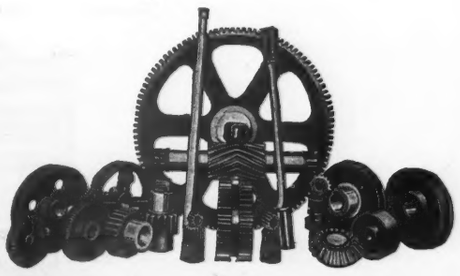
One "Tool Steel" Wheel *did the work of* Twelve Untreated Crane Wheels

This change to "Tool Steel" showed a net saving per wheel of $410.48.

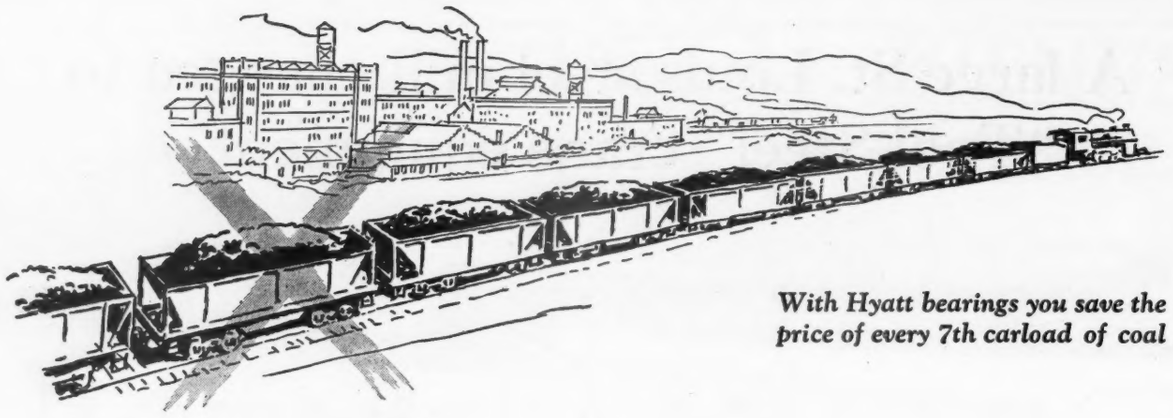
No wonder this manufacturer is a constant user of "Tool Steel" wheels.

Section from hardened track wheel, showing ideal wearing surface on tread and flange but tough flange center to prevent breakage.





The Tool Steel Gear and Pinion Co.,
CINCINNATI, OHIO



With Hyatt bearings you save the price of every 7th carload of coal

Let proved power saving govern your choice of bearings

Although there are other advantages to be considered in the selection of line shaft bearings, in the final analysis power saving should be the deciding factor.

An assured 15% saving on your total power bill—and in many cases more—makes Hyatt Line Shaft Roller Bearings an economic necessity in your plant.

A typical example of Hyatt power saving is found in these figures.

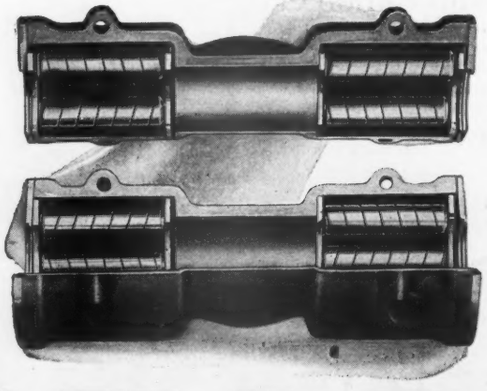
A plant appropriated $10,000 to replace babbited line shaft boxes with Hyatt Roller Bearings.

They saved $5,400 the first year on power (15% on 900 H.P. at $40 per H.P.); $750 on maintenance (75% of $1,000); $240 on lubrication (80% of $300). This total of $6,390 represents a return of 63.9% on the initial investment. In another seven months the bearings paid for themselves.

Whether your plant is large or small—Hyatt Roller Bearings will prove a paying investment.

HYATT ROLLER BEARING COMPANY

Newark Detroit Pittsburgh Chicago Oakland



Completely split for quick, easy installation

HYATT

ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS

The STURDOX

A New Benjamin Two-Piece Easy-to-Wire Lighting Line

A new line of sturdy industrial lighting fixtures which combine durability with economy.

Where ordinary lighting equipment would speedily deteriorate, "Sturdox" fixtures will survive over long periods of extra severe service.

Hoods and reflectors are easily separable for cleaning or interchange of reflector.

Two types of hoods and four styles of reflectors give 16 combinations of equipment to meet most industrial lighting requirements.

Exclusive Features

Sockets are easy to wire and convertible from medium to mogul base without disturbing wiring.

Lamp Grip keeps lamp from working loose. Avoids arcing and prevents lamps from falling under heavy vibration.

Available if Specified

Shock Absorbing Socket protects lamp filament from shocks and jars—reduces lamp replacement costs.

Self-Locking Socket prevents theft or unauthorized removal of lamps.

Pull Chain Socket gives individual control to each lamp. This is the only pull socket with the chain coming down inside of reflector.

PENDANT AND OUTLET BOX HOODS
IN CAST IRON AND STAMPED STEEL
RLM BOWL SHALLOW BOWL ANGLE Reflectors
ROLLED COPPER SCREW THREAD NECK
BENJAMIN

Stamped Steel Pendant Hood with RLM Standard Dome Reflector

Stamped Steel Outlet Box Type Hood

Cast Iron Outlet Box Type Hood

Cast Iron Pendant Type Hood

Embodying Convenience, Economy and Long Life

Send for Descriptive Bulletin giving full information and prices

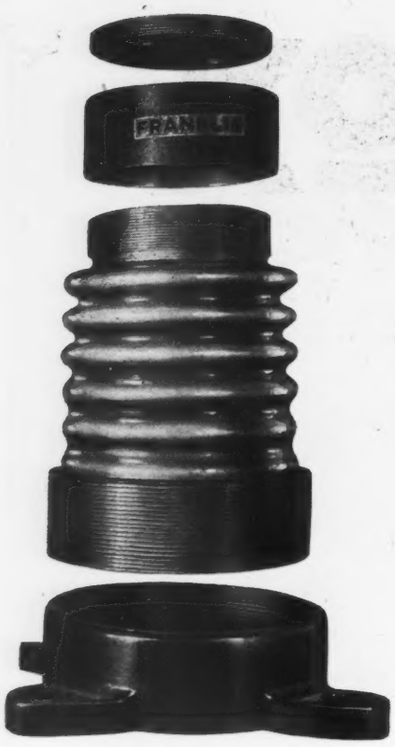
Benjamin Electric Mfg. Co.

120-128 S. Sangamon Street

New York: 247 W. 17th St. — Chicago — **San Francisco:** 448 Bryant St.

BENJAMIN

TRADE MARK



Here's where the strength lies

in Type T die-cast metal construction

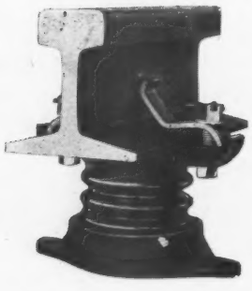
Die-cast metal constructed insulator posts for indoor Bus Supports and Switches give maximum strength and safety under severe stresses —gets the full value from the insulation—and is vibration-proof.

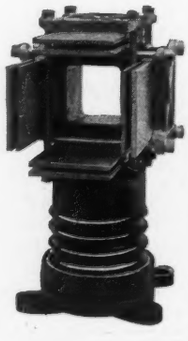
Arrows point to the die-cast metal bands which are threaded to connect hardware to porcelain. Metal is shrunk on and thus evenly distributes any strain or pressure on the insulator.

Below are several examples of various services to which this type of construction is particularly well adapted.

We have a representative near you. Inquire about die-metal construction.

"Install the FRANKLIN *and forget it."*





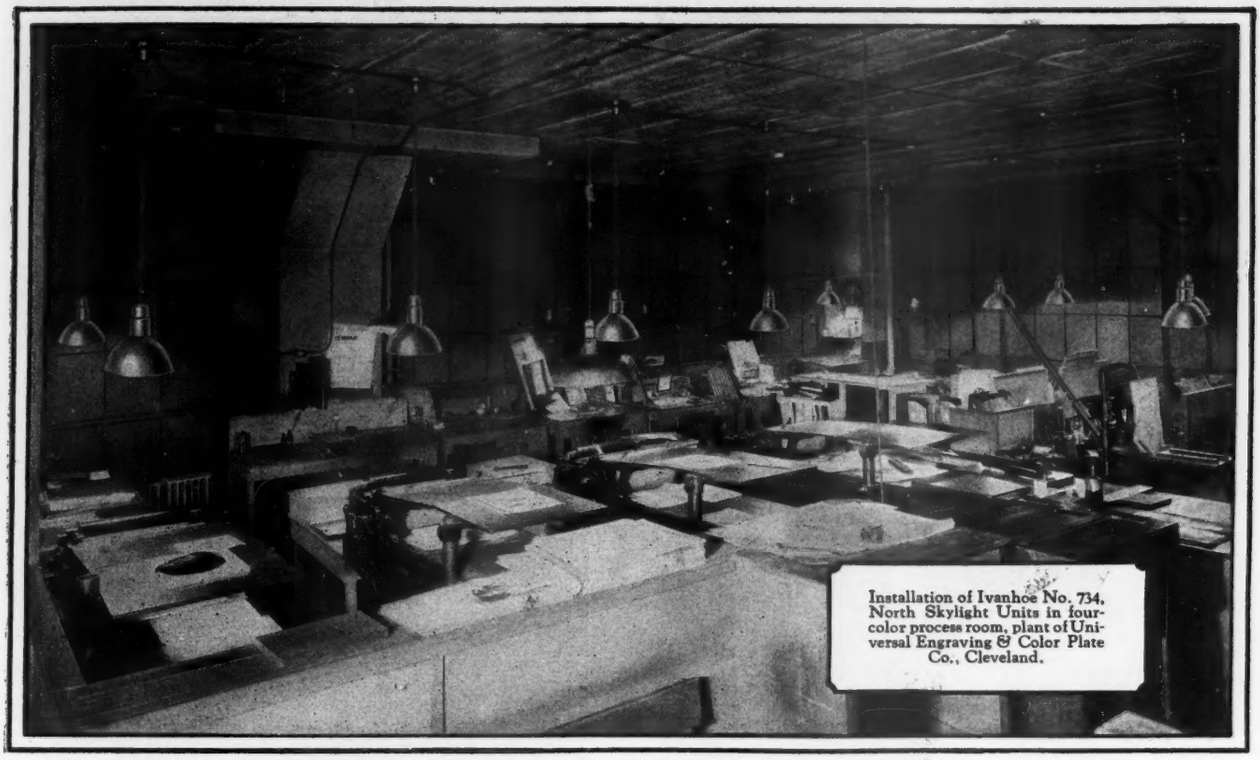
RAILWAY AND INDUSTRIAL ENGINEERING CO.

GREENSBURG, PA.

Boston, New York, Philadelphia, Cleveland, Pittsburgh, Cincinnati, Chicago, St. Louis, Charlotte, Albany

R&IE *for Outdoor* FRANKLIN *for Indoor*

Birmingham, Buffalo, Casper, Dallas, Denver, Houston, Indianapolis, Los Angeles, Seattle, Salt Lake City, San Antonio, Syracuse, New Orleans, Rochester, San Francisco



Installation of Ivanhoe No. 734, North Skylight Units in four-color process room, plant of Universal Engraving & Color Plate Co., Cleveland.

Ivanhoe Trutint Units Help Artists Match Colors for Universal Engravers

Ivanhoe RLM standard dome reflector. Distributes light scientifically. Also standard bowl and angle reflectors.

Ivanhoe Glassteel Diffuser Produces diffused illumination of highest quality. Latest development for industrial lighting.

Ivanhoe vapor-proof unit. For use where protection from dust or fumes is required.

In the manufacture of four-color process plates, colors must be matched *accurately!* That is why Universal Engraving and Color Plate selected Ivanhoe Trutint Units for lighting their four-color process shop.

Ivanhoe Trutint Units are made for industries where it is desirable that artificial illumination blend with daylight, or where accurate discrimination of colors and tints is essential. The textile, food, printing, tobacco, dye and paint industries, for instance. Units to provide a true north skylight or a noon sunlight are available.

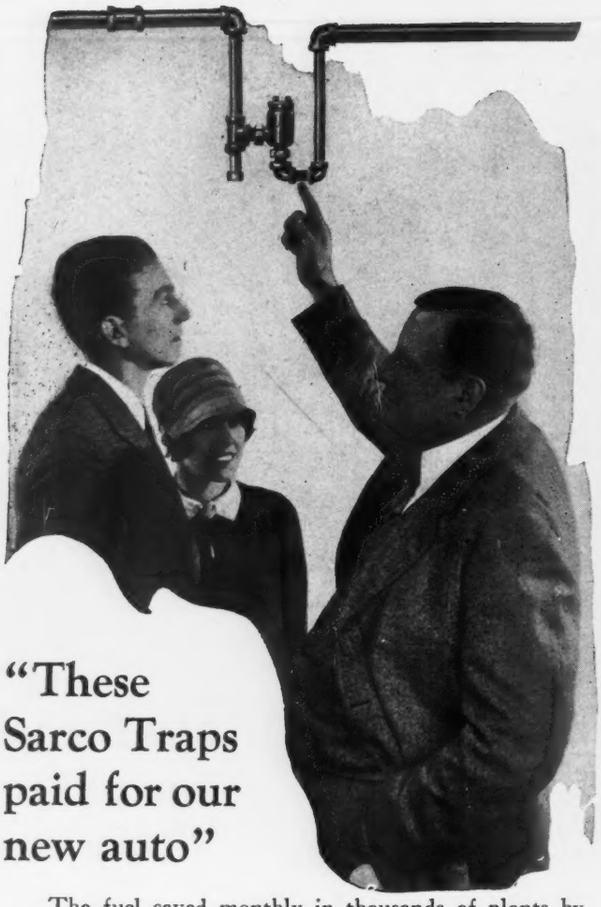
The complete Ivanhoe line includes standard equipment for the regular lighting job, and special equipment for the unusual and often difficult job. All, plus a helpful engineering service. Write for catalog.

IVANHOE DIVISION
of THE MILLER COMPANY
Cleveland, Ohio

Ivanhoe industrial flood lighting unit. Makes light penetrate smoke or steam. May be mounted high.

Ivanhoe dust-cover unit. Protects surface of the reflector from deterioration from smoke, steam, etc.

Ivanhoe Trutint unit. For use where artificial light must blend with daylight, for color matching, etc.



"These Sarco Traps paid for our new auto"

The fuel saved monthly in thousands of plants by Sarco Steam Traps is sufficient to more than pay for an automobile.

The coal saving in one plant averages $7,500 per month. Another saves about $5,100 monthly. Even in small plants, almost unbelievable savings are frequently effected.

SARCO STEAM TRAPS

cost only one-third the price of most traps. And there is practically no installation cost, for they're self adjusting for all pressures from 0 to 100 lbs. and they screw right into the pipe line, doing away with supports or pit.

Let us send you a Sarco on 30 days' free trial. You'll then see for yourself that it will do the same work as large, costly traps.

SARCO CO., INC.

183 Madison Ave., New York

Boston Chicago Detroit
Buffalo Cleveland Philadelphia
Adolph Frese Corp., Los Angeles
Peacock Bros., Ltd., Montreal

Free Trial Coupon

Sarco Co., Inc.,
183 Madison Ave., New York.

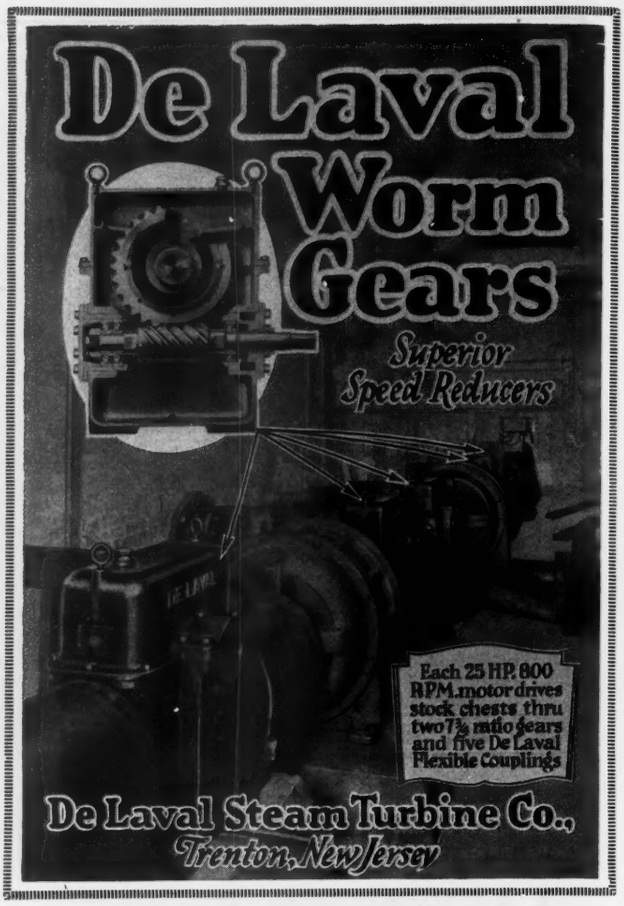
Please send the following on 30 days' free trial:

☐ No. 9 Sarco Steam Trap, size.... (½", ¾", 1").
☐ Booklet R-288.

Name .....

Address .....

City .....


De Laval
Worm
Gears
Superior
Speed Reducers
Each 25 HP. 800 R.P.M. motor drives stock chests thru two 7½ ratio gears and five De Laval Flexible Couplings
De Laval Steam Turbine Co.,
Trenton, New Jersey

Quickest, safest and most economical means of blowing the dust from motors and other electrical equipment. Dry air; no condensation. Norma Ball Bearings; no oiling. Write for descriptive folder and trial offer.

CLEMENTS MFG. CO., 617 Fulton St., Chicago, Ill.

Service no weather can delay

THREE weeks to the close of Great Lakes navigation in Wisconsin—the winter's coal supply yet to be unloaded from the barges by the Company's coal tower—ice already forming.

And then—the main hoist motor went out of service.

In response to a long distance call for help, two G-E Service Shop men were on their way that night. Rewinding of both stator and rotor was required. The rotor was sent back to the Service Shop for repairs, while the men worked at the top of the tower for five days rewinding the stator, unprotected from the rapidly dropping temperature. Eleven days after the emergency arose, the coal was again being hoisted.

Such is the G-E standard of service. It pays to feel that men who know how will take care of you in an emergency. There are G-E Service Shops in 21 cities. There is one near you.

You are never out of reach of G-E Service. Express will reach the nearest Service Shop overnight. If the job is too large to ship, experienced men will come to you. Our shops are located in the following cities:

Atlanta	Erie	Oakland
Buffalo	Fort Wayne	Philadelphia
Chicago	Kansas City	Pittsfield
Cincinnati	Los Angeles	St. Louis
Cleveland	Lynn	Salt Lake City
Dallas	Minneapolis	Schenectady
Detroit	New York	Seattle

GENERAL ELECTRIC

Holabird & Roche, Chicago, Architects
George A. Fuller Co., Chicago—New York, General Contractors
J. Livingston & Co., Chicago, Electrical Contractors

The STEVENS HOTEL, Chicago

Wired Throughout with

American Steel & Wire

Company's

Rubber Covered Wire

TWO million feet of rubber covered wire were used to completely wire all of the 29 floors, 3000 guest rooms, several kitchens, ballrooms, banquet and meeting rooms, hallways, reception parlors, lobbies and other parts of this magnificent new hotel recently completed on Michigan Boulevard, Chicago. Only the very finest material and the most rigid specifications were approved for this great building. The selection, therefore, of our wire to meet these demands expresses most forcefully the uniform and dependable quality of the product, and further gives striking evidence as to the standing with leading architects and contractors.

Let us send you our indexed catalog and handbook of electrical wires and cables. Estimates furnished promptly from any of our offices in all of the principal cities.

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		WORCESTER	94 Grove Street
ST. LOUIS	506 Olive Street	BALTIMORE	32 So. Charles St.
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MEMPHIS	Union and Planters Bank Bldg.	*LOS ANGELES	2087 E. Slauson Ave.
DALLAS	Praetorian Building	*PORTLAND	6th and Alder Sts.
DENVER	First National Bank Bldg.	*SEATTLE	4th Ave. So., & Conn. St.
SALT LAKE CITY	Walker Bank Bldg.	*United States Steel Products Company	

Do your **COMMUTATORS** run **HOT?**
Do you have **DESTRUCTIVE SPARKING?**
Are your **BRUSHES** wearing **GROOVES?**
Are your **MACHINES NOISY?**

Eliminate all these troubles and Prolong the Life of Machines

by equipping them with

The original and improved

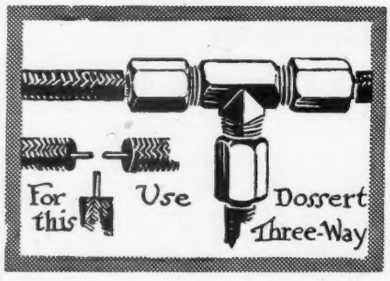
Reaction Brush Holder

over 20 years in service

Let us equip a Generator or Motor for *you.* Make its *final acceptance* subject to your *approval after any reasonable period of operation.*

THE BAYLIS CO.

50 Nelson Street
BLOOMFIELD, N. J.

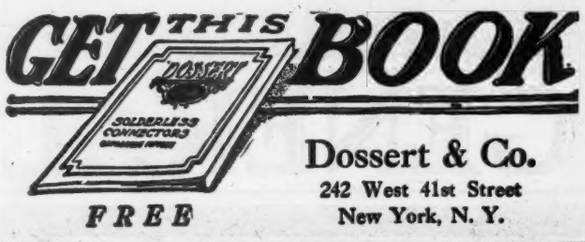


To make a 3-way splice

Better conductivity at the joint than in the wire itself, is a condition you always have with any of the Dossert connectors.

—all due to the Dossert principle—the tapered sleeve.

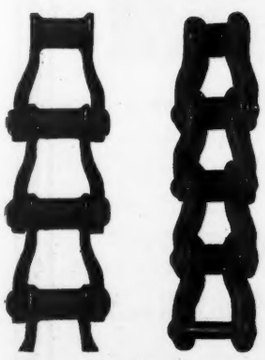
The Dossert 20th Year Book shows you the economy these connectors give you.



Dossert & Co.
242 West 41st Street
New York, N. Y.

Belt Conveyors
Bucket Elevators
Screw Conveyors
Weigh Larries
Coal Crushers
Ash Skip Hoists
Flight Conveyors
Track Hoppers and Feeders
Pivoted Bucket Carriers
Lehr Conveyors
Coal Bunkers and Gates
Power Transmission Machinery
Barrel and Box Elevators
Elevator Buckets
Car Pullers
Bag Elevators
Steel Chains
Malleable Iron Chains
Sprockets

Get our prices on the items you are interested in!



Webster installations —throughout industry

"Lower production costs" is a slogan in American industry which Webster equipment is helping to make a reality.

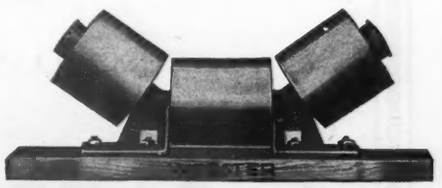
In the modern trend toward the use of labor-saving equipment WEBSTER installations are specially built for mechanical production and the saving of man power.

Webster engineers are constantly studying the problem of production costs. Every Webster installation is planned with this element in view—to give dependable, day-in-and-day-out service and the delivering of the finished product at the very minimum cost figure.

Webster elevating and conveying systems; screening equipment; coal and ashes handling machinery; bucket elevators; belt conveyors; screw conveyors; feeders; weigh larries; pivoted bucket carriers—*these are a few items from the complete Webster line.*

THE WEBSTER MANUFACTURING CO.

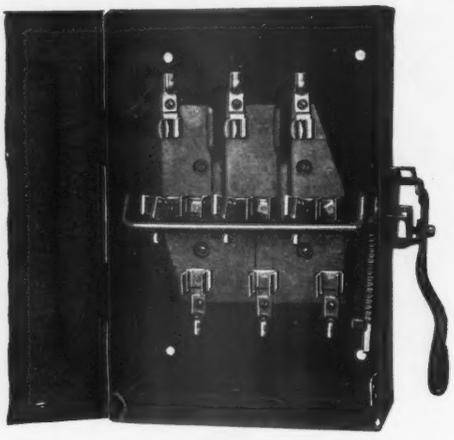
1856 No. Kostner Avenue,
Chicago, Illinois



New York *Philadelphia* *Pittsburgh*
Cincinnati *Cleveland* *Buffalo*

WEBSTER —Write to—

Type "C" A Good All-Round Safety Switch



Type "C" Safety Switch

Quick Make and Break

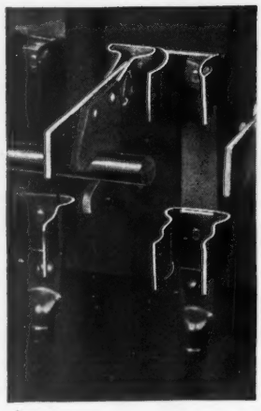
Removable Handle

The Type "C" Safety Switch is built for light industrial loads although it is adaptable to many uses outside the industrial field. It is a good all around safety switch. Several new features have been added and we call your particular attention to them here.

1. Quick Make and Break mechanism.
2. Removable Handle, saves breakage in shipping.
3. An insulated blade construction which allows fuses to be taken out easily. Reduces size of panel.
4. Ample wiring space.

These switches supplement our line of higher priced Type "A" Switches for mill purposes. Our concentric knockouts leave the hole clean as a hound's tooth.

Do you want more information about these Type "C" Safety Switches? Just drop us a line.



Blade Construction

TRUMBULL-VANDERPOEL ELECTRIC MFG. CO.
BANTAM, CONN.

NEW YORK BOSTON CLEVELAND CHICAGO DETROIT PHILADELPHIA

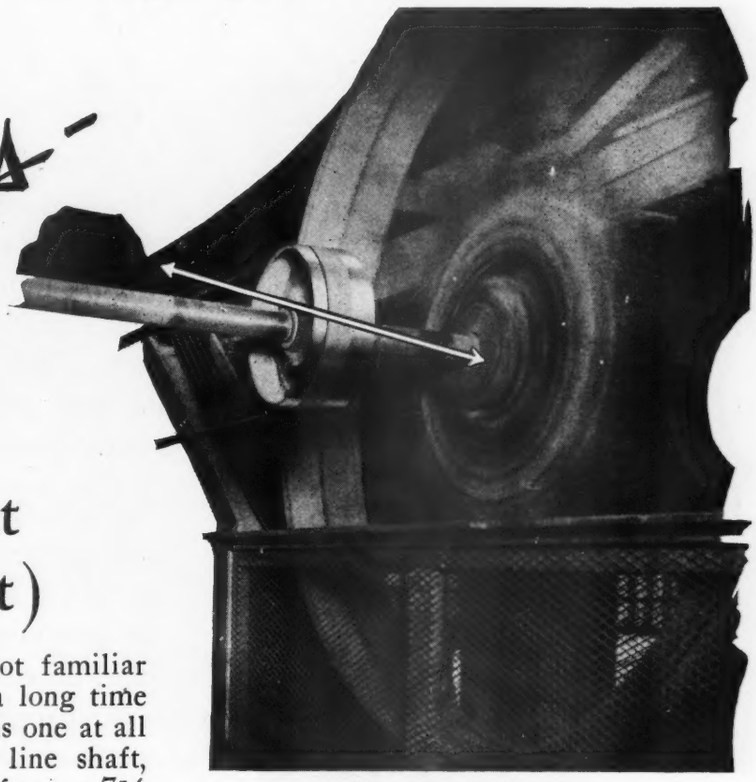
On the Pacific Coast—C. Dent Slaughter

SAFETY SWITCHES

TENTACULAR

"The Belt with the grip of an Octopus"

Ideal for short centers—



(—and here's what we mean by short)

Almost any engineer who was not familiar with Tentacular would hesitate a long time before considering a drive like this one at all possible. And yet, here is this line shaft, heavily loaded, taking its power from a 7¼ inch pulley. The shaft pulley is 7½ *feet* in diameter and the center to center distance is only 9 feet. In spite of this enormous ratio and close separation, the top of the belt is slack, and there is no measurable slippage. Why?

Because Tentacular clings to the pulley surfaces. Its under surface is soft chrome tanned leather, fastened by hollow rivets to a sturdy, seasoned, oak leather base. The suction created when the belt is in motion prevents the slip common to any belt on drives of high pulley ratio.

Idlers are unnecessary. Low belt tension is the rule. Slippage is practically eliminated. Pulley faces need no grooving nor change. And the Tentacular belt lasts for years and years.

TENTACULAR

will positively increase speed and machine production by cutting down belt slip—will lower power costs by lowering belt tensions and friction loss.

Tentacular will eliminate the idler in a majority of drives. Tentacular should be used wherever belt tensions are high.

Tentacular should be used wherever pulley ratios are high and short centers are unavoidable.

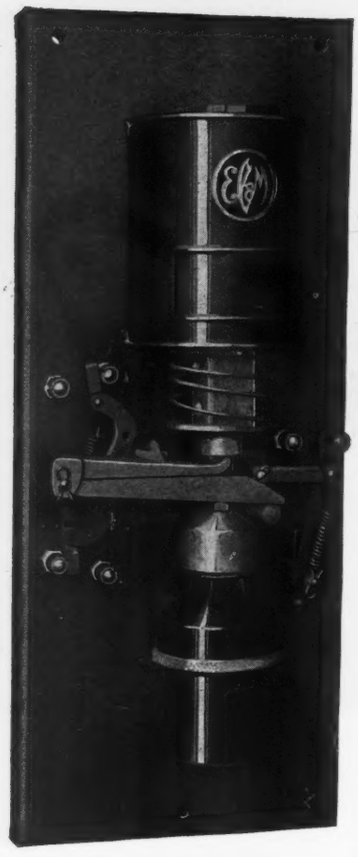
Let us talk it over with you.

CHICAGO POWER SHOW FEB. 14-18

Alexander Brothers, (INC.)

14 SOUTH STREET, PHILADELPHIA, PA.

An Accurate Time Delay Relay



This new relay operates to open a circuit or to close a circuit after a predetermined time interval, which may be as long as two minutes. The timing is adjustable for any period throughout the operating range of the relay.

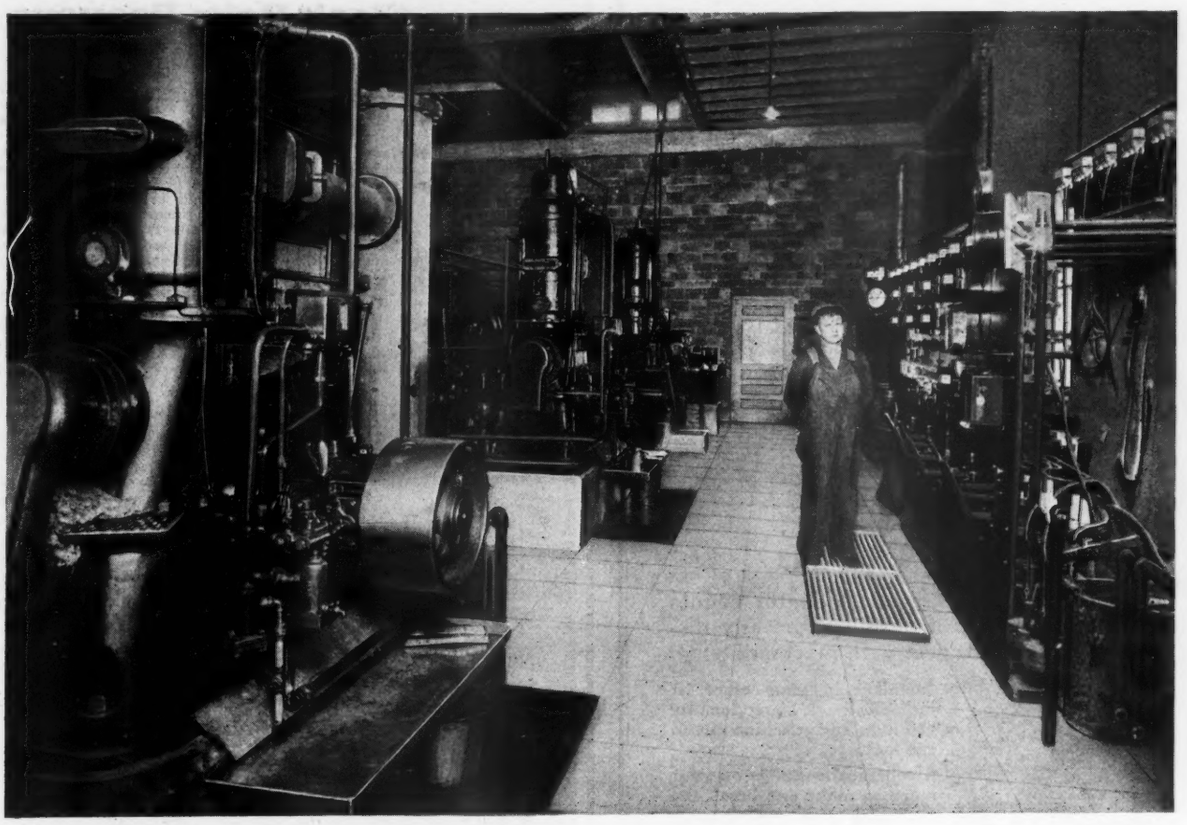
The time delay is secured by the escapement of mercury through an orifice and is very accurate. No dash pots are used, no pendulums, no clock work. Temperature changes do not affect the operation or accuracy.

Type HG Relays are made for operation on alternating or direct current circuits.

Type HG Relays have many applications. They are used with synchronous motor starters for controlling the D.C. field contactor. They are used with automatic skip hoist controllers for holding the skip stationary in the dumping position for several seconds to permit it to discharge its load; for introducing a delay in the sequencial starting or stopping of an interlocked conveyor system; and, in fact, for any service requiring an accurate and dependable time delay relay.

THE ELECTRIC CONTROLLER & MFG. CO.

NEW YORK-50 CHURCH ST. **CLEVELAND, OHIO** PHILADELPHIA-WITHERSPOON BLDG.
CHICAGO-CONWAY BLDG. PITTSBURGH-OLIVER BLDG.
DETROIT-DIME BANK BLDG. LOS ANGELES-912 E. THIRD ST. SAN FRANCISCO-CALL BUILDING
BIRMINGHAM-BROWN-MARX BLDG. SALT LAKE CITY-228 SO. W. TEMPLE MONTREAL-DRUMMOND BLDG
CINCINNATI-1ST NATIONAL BANK BLDG. TORONTO-REFORD BLDG. TULSA-217 E. ARCHER ST.



"I'm Strong for Nonpareil Diesel Oil"

Read what J. L. Prier, Superintendent of Light and Water Hugoton, Kansas, Has to Say:

"A few years ago we began using Nonpareil Diesel Oil in our three Fairbanks-Morse engines.

"No longer is it necessary to tear down our engines and clean out the carbon after short periods of operation. This, we were forced to do with other oils we have used.

"Recently, we inspected one of our Type Y, 50 H. P. engines and found very little carbon after a twelve months' run. Our large engine, a new Type Y, 120 H. P., was started on Nonpareil Diesel Oil in May, 1925. It has carried a full load twelve hours per day and as yet we have not pulled a piston, taken up a rod bearing or cleaned the carbon out of the exhaust system.

"So great is our satisfaction with Nonpareil Diesel Oil that we are afraid when the time does come to tear down our enignes, we will have forgotten how to begin."

To assist operators of Diesel Engines in obtaining the correct grades of lubricants, we offer the services of our Lubrication Engineers. These men are qualified to recommend the proper grades of oil for your use. To avail yourself of this service does not obligate you in any way.

Just phone or write our nearest branch office

CHICAGO POWER SHOW FEB. 14-18

STANDARD OIL COMPANY
(INDIANA)
General Offices: 910 S. Michigan Avenue CHICAGO, ILLINOIS

To Call a Halt On Spendthrift "Automatics"

The operating and maintenance cost of an automatic machine may be three times as great as the expense of a simple machine. When the "automatic" isn't running full time, it's running away with your money—fast.

There's now a Counter to tell—in your office—when a machine in the shop isn't running, or producing enough. It's the new *Alternating Current MAGNETIC*

Veeder

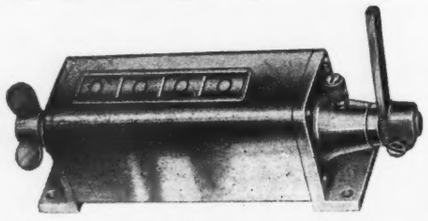
This "Form US" Magnetic Counter counts operations or units of output, from any distance that wires connect with machines.

Cut ½ size

Installed in your office, it indicates work being done by the man and machine out in the factory.

Mechanical contacts on your machine make and break the electrical circuit which operates the counter. The electro-magnetic drive can get its current from your regular lighting circuit, **alternating current,** either 55, 110 or 220 volts, as ordered. For operation by **direct** current or storage battery, specify "Form UM" Magnetic Counter. For alternating current, "Form US."

The *Set-Back Rotary Ratchet Counter* below counts one for each oscillation of the lever, as required in counting the product of presses.



Goes directly on machine; non-magnetic. Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as needed. Price with 4 figures as illustrated, $11.50 (subject to discount). Equipped with lock and keys to prevent tampering with the record, $2 extra. (Cut ½ size.) Set-Back *Revolution* Counter of similar model, price $10.00 (list).

Write for the full-line Veeder booklet of mechanical and magnetic counters.

The Veeder Mfg. Co.

31 Sargeant Street, Hartford, Conn.

Slack Belts Prevent 3 Costly Belt Evils

Depending of course upon the number of belts used in a plant, savings of many dollars a year are being regularly made by running belts slack (instead of tight), after treatment with Cling-Surface. Slippage is reduced to natural creep, bearing troubles from strain of tight belts eliminated, and the life of belts greatly prolonged because of new flexibility and preservation.

A special survey by engineers in a New England mill (name on request), where over 500 belts had been treated with Cling-Surface, uncovered an average saving of $25.70 per year per belt—this does not take into consideration power savings, which could not be accurately checked.

Prove Cling-Surface benefits and economies to your own satisfaction with a 60-day approval test—or do not pay us one cent. Let us send trial quantity at $3.50 per one gal. size; 3 gals. at $3.40 per gal.; 6 gals. at $3.25 per gal. State whether conditions are warm, dry, dusty, or reverse. Cling-Surface Co., 1020 Niagara St., Buffalo, N. Y.

Openings for good salesmen

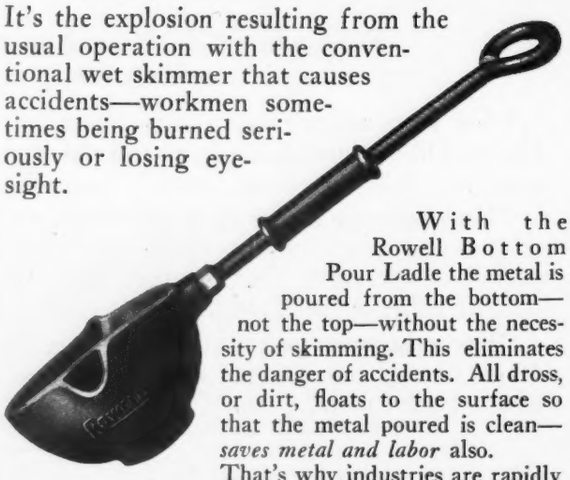
Cling-Surface

SCIENTIFIC BELT TREATMENT

KNOWN FOR 30 YEARS

Protect Your Workmen Against Accidents when Pouring Metals

It's the explosion resulting from the usual operation with the conventional wet skimmer that causes accidents—workmen sometimes being burned seriously or losing eyesight.



With the Rowell Bottom Pour Ladle the metal is poured from the bottom—not the top—without the necessity of skimming. This eliminates the danger of accidents. All dross, or dirt, floats to the surface so that the metal poured is clean—*saves metal and labor* also.

That's why industries are rapidly adopting the Rowell Bottom Pour Ladles. Let us tell you more about this ladle.

ROWELL MFG. CO., Appleton, Wisconsin

ROWELL

Listed as Standard by Underwriters Laboratories.

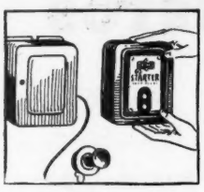
C-H *across the line*

9586 "AAA" Automatic A. C. Starter

Big Starter Capacity
Big Starter Features
Big Starter Performance

in this New Midget Starter

at a new low cost!



So small that many users install the starter where the push-button station would ordinarily be placed. The "AAA" has "start" and "stop" buttons right on the case, but as many additional push-button stations as desired may be placed where needed.

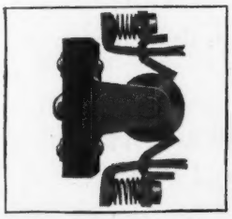
THE new Cutler-Hammer 9586 type "AAA" Across-the-Line Starter sets many new standards. In size, it is smaller than anything ever built with Thermal Overload—for such large capacity.

In price, it establishes a new low cost for the advantages of push-button Control, making it possible now to have this desired and modern type of starter on hundreds of thousands of motors where cost previously prohibited it.

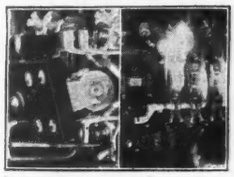
In efficiency, it marks an amazing advance in Motor Control development. Five horsepower capacity in less space than required for a 'phone box. Push Buttons incorporated —no extra wiring to place Motor Control at the operator's finger tips.

From every viewpoint, this C-H 9586 type "AAA" Automatic A. C. Starter is entirely new—bringing unprecedented savings and words of praise wherever installed.

The CUTLER-HAMMER Mfg. Co.
Pioneer Manufacturers of Electric Control Apparatus
1219 St. Paul Avenue
MILWAUKEE, WISCONSIN



The latest C-H development—roller, double-break contactors. Practically eliminates arcing.



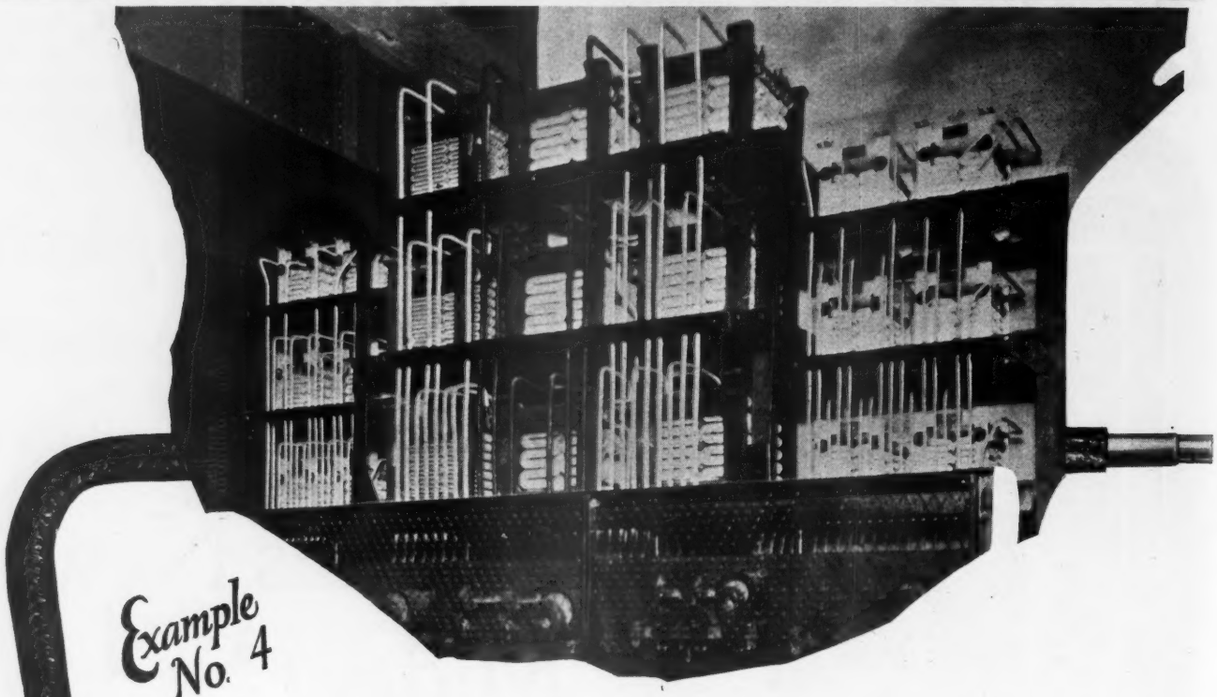
Left—Contactors of the "AAA" taking a stalled 7½ H. P. motor off the line. Note the arcing is almost invisible.
Right—An ordinary starter operating under identical conditions. Note the arcing is heavy by comparison to the "AAA."

The interior—note "pick-out" arc shields. No tools required for removal. By loosening one screw entire panel may be removed for wiring.

CUTLER C-H HAMMER

Industrial Efficiency Depends on Electrical Control

WHY WHEN and WHERE TO USE ROCKBESTOS —*the asbestos covered wire*



Example No. 4

Rockbestos has been developed for the electrical industry's use on furnaces, ovens, switchboards, controllers, boiler room lighting circuits, motor leads and internal connections and other equipment requiring wire immune to heat.

Here is a typical opportunity for ROCKBESTOS

Conditions existing in proximity to this resistor bank of a starting panel vividly illustrate the reason for using Rockbestos —the asbestos covered wire—for any condition where high temperature might damage equipment or interrupt operations.

Frequent starting of motors generates heat. Motor starting resistors are maintained at high temperature—frequently becoming red hot. Rockbestos insulation is built to withstand these extreme conditions. It will not disintegrate or deteriorate even after long use.

Our engineers will gladly co-operate with you on any special application.

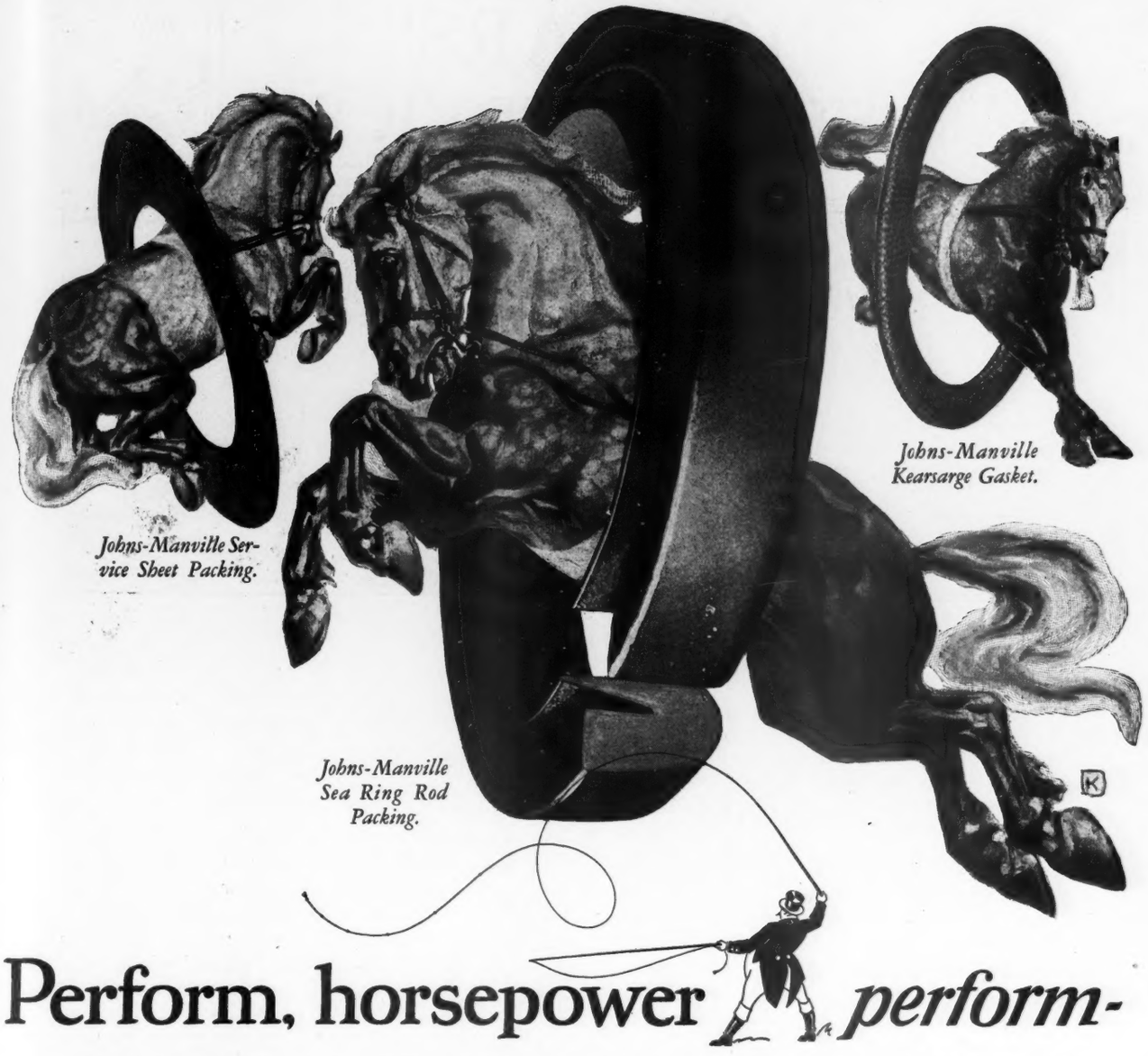
Our new Bulletin on Rockbestos Wires and Cables sent on request.

ROCKBESTOS PRODUCTS CORPORATION

NEW HAVEN, CONN.

5942 Grand Central Term. Bldg., New York, 465 Union Trust Bldg., Pittsburgh, Pa., 224 Madison Term. Bldg., Chicago

On the Pacific Coast—Allied Industries, Inc.



Perform, horsepower perform-

Queer looking hoops, aren't they? Yet they are directly responsible for the fine performance of horsepower in many an industrial plant. They are Johns-Manville Packings.

As the washer in your kitchen faucet prevents water leakage, so do these packings prevent steam leakage in power plants . . . and save horsepower.

They are only a few of the highly efficient group of packings, insulations and refractories, based on Johns-Manville Asbestos and allied materials.

These products and the Johns-Manville men who sell them, power specialists they are, constitute a Johns-Manville Service to Industry of great value in the industrial field.

Shrewd plant engineers know this and regularly call upon Johns-Manville . . . men and materials . . . to reduce operating costs by getting finer performances from horsepower.

ASBESTOS SAVES HORSEPOWER

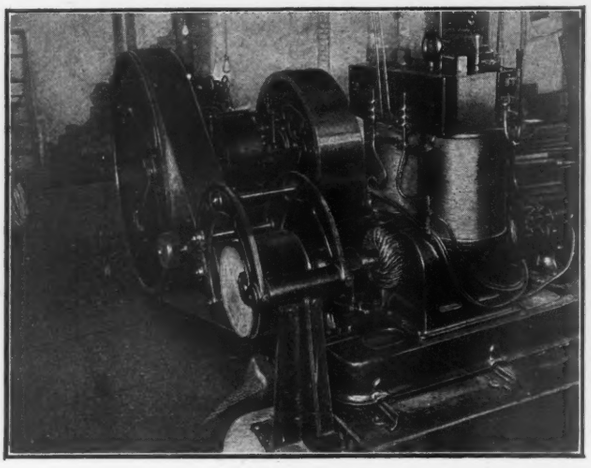
Asbestos

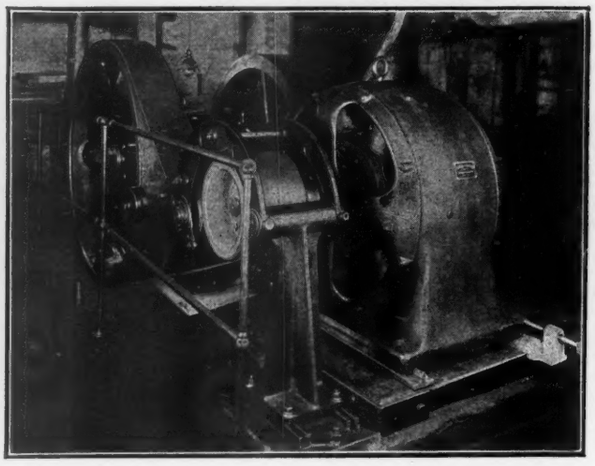
JOHNS-MANVILLE

SAVES HORSEPOWER

JOHNS-MANVILLE CORP., MADISON AVE. AT 41ST ST., NEW YORK. BRANCHES IN ALL LARGE CITIES. FOR CANADA: CANADIAN JOHNS-MANVILLE CO., LTD., TORONTO

19 YEARS' STEADY SERVICE





65 H.P. Steam Engine Driven Generator.
Pulley Centers 6-ft. 6-in.

THE original open drive connecting a 65 H.P. steam engine and a bi-polar generator on 16-ft. 0-in. centers gave continuous trouble because of excessive belt slippage.

In 1908, a LENIX was installed, as illustrated above at the left. The LENIX eliminated all actual belt slippage, gave efficient transmission of the power and in general, improved the operating conditions. Incidentally, the LENIX permitted the installation of these units on 6-ft. 6-in. centers, saving about ten feet of valuable floor space.

For *seventeen years,* this installation was in daily service and, with the exception of one new belt, the outlay for upkeep was in the words of the superintendent, "not a cent."

In 1925 the old steam engine and generator were replaced by modern units, and as illustrated above at the right, the old LENIX was used with the new equipment.

This record of over *nineteen years* of daily service is proof of the reliability and soundness of design and construction of the LENIX. This installation is only one of many still in service after nearly twenty years of operation. There are now thousands of LENIXES installed on drives in units of from 1 H.P. to 1400 H.P. in practically every industry.

The LENIX Saves

- Power
- Building Space
- Belting
- Bearing Friction
- Lubrication
- Maintenance Cost
- First Cost of Motors, Generators, etc.

On drives 1-1400 H.P., and up.

The LENIX is the pioneer short center belt drive. Our extensive experience, the result of more than twenty years of designing and building LENIXES, is offered for the solution of your belt drive problems.

A card will bring you full information.

The LENIX Drive

(Trademark Registered)

F. L. SMIDTH & CO.

Engineers

40 Church Street, New York, N. Y.

THUMBNAIL HISTORIES

CHAPTER 9

The doctor takes his own medicine!

We have our problems of cost and production just the same as any other manufacturer. And our Works Manager, when he needs motors, is far more interested in performance than name plates.

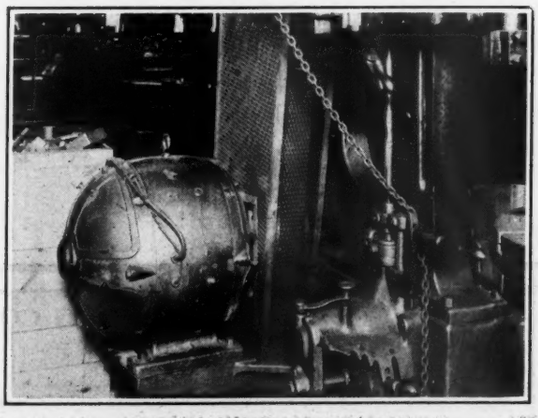
The motors in our plants are Electro-Dynamic motors simply because they give us the kind of service that enables us to produce their mates most efficiently. One of our production motors, for instance, has been driving a boring mill in our machine department for the past 20 years and is still in daily operation. This, as you know, is a mighty tough job, and the motor, naturally, of an old type. Yet we give you our word, as progressive manufacturers, that maintenance is, and always has been, extremely low. Never once has this motor caused us loss by breaking down.

Maybe you, too, have been looking for just this kind of motor service. If so, we will gladly give you further details and plenty of operating data.

Write us.

ED

The Pioneer Manufacturer of Ball Bearing Motors



The Interpole Direct Current Motor

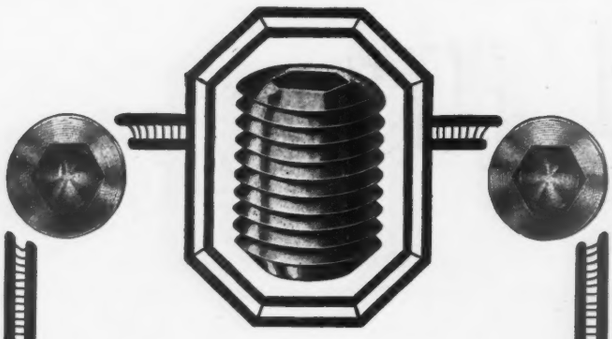
Electro Dynamic engineers were first to build a successful INTERPOLE D.C. motor. Since that time the design has been widely imitated and has found application in every branch of industry, particularly on machine tools.

High efficiency, utmost simplicity, and accurate control of speed make E.D. Ball Bearing D.C. Interpole Motors by far the most satisfactory installation for machine tool operation. Many of our earlier units are still operating after years of everyday service. Bulletins of both D.C. and A.C. equipment for every industrial purpose on request.

Electro Dynamic Company, Bayonne, N. J.

Established 1880

Manufacturers of Direct and Alternating Current Motors



For One Cent

It is not the cost of set screws, but the enormous cost of set screw *breakage* which makes careful buying imperative.

There is less than one cent's difference in price between the strongest and weakest hollow screw:—between a cold-drawn ALLEN and an ordinary broached screw.

But for that same broached screw *broken down*, add the cost of mechanic's time digging out the screw. Add the cost, perhaps, of dismantling a machine. Add your loss in production.

Would you risk these things—for *one cent?*

The Allen Mfg. Co.

127 Sheldon St., Hartford, Conn.

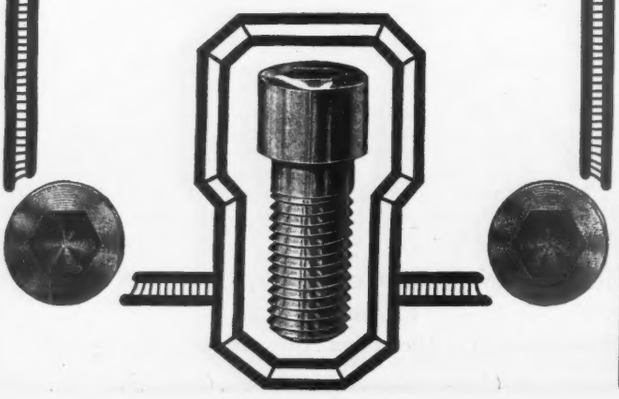
Branch Offices:

W. C. Stauble
2909 Waverly St.
Detroit, Mich.

R. E. Gregory
1029 Wesley Ave
Evanston, Ill.

E. P. Crawford
3348 No. Park Ave.
Philadelphia, Pa.

W. J. McRae
320 Market St.
San Francisco, Cal.

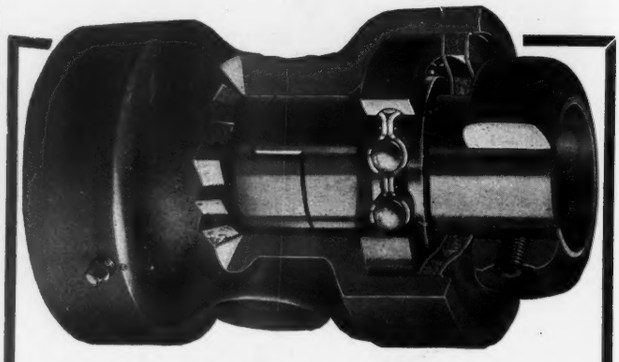


Your Plant

Can Avoid Breakdowns If You Install

"CHICAGO LINE"

Ball Bearing Appliances



Daggett Ball Bearing Hanger Box

TODAY, the demands for increased production and economy often necessitate a continuous running plant. Shut-downs, caused so often by burnt out bearings where old style equipment is used, are costly in the extreme.

"Chicago Line" Ball Bearing Equipment now has made this waste unnecessary. If you install "Chicago Line" Equipment, friction need never bother you again.

The Daggett Ball Bearing Hanger Box is simply constructed, easy to install and fits any standard hanger frame. It is noiseless, dustproof, will operate at any speed without heating and cannot wear the shaft. Just oil it a few times a year and forget it the rest of the time.

Let our transmission engineers tell you how to reduce your Fire Hazard!

CHICAGO PULLEY & SHAFTING CO.
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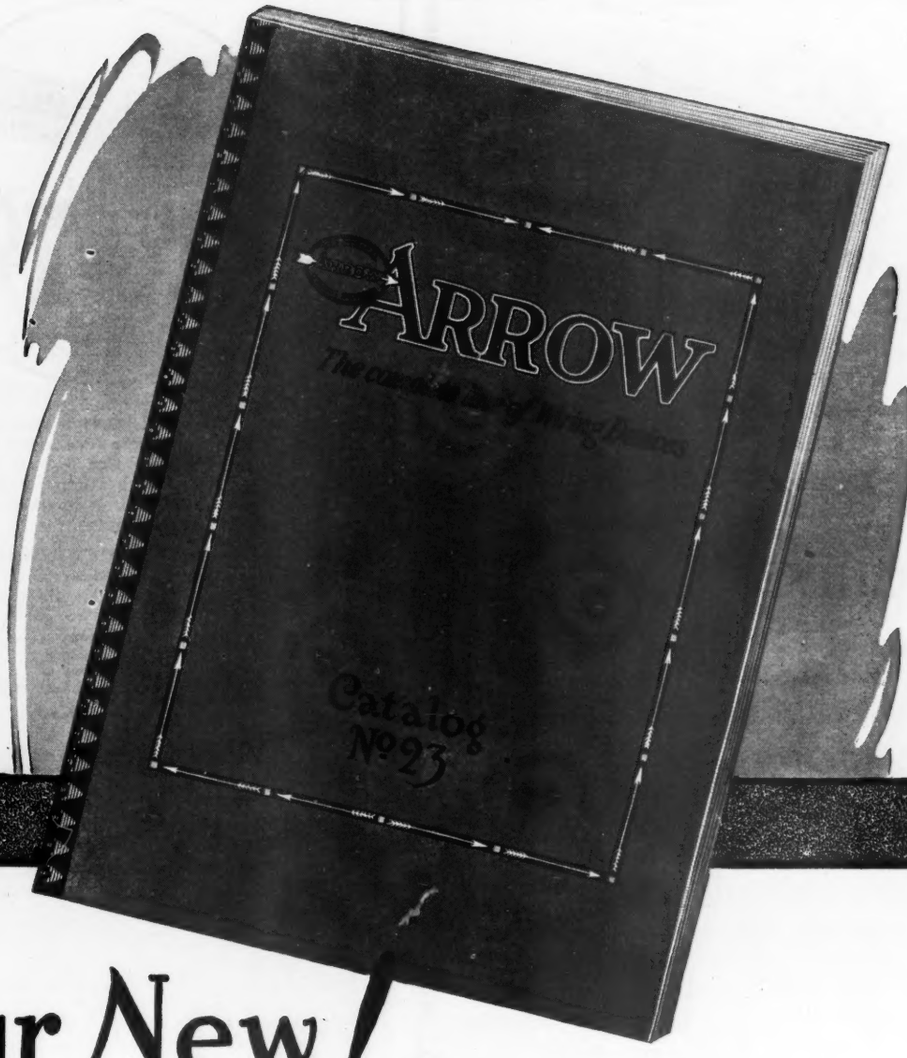

Our New Catalog

The Arrow Electric Company is now ready to place at your disposal their new Catalog No. 23 listing a complete line of Industrial Wiring Devices.

New devices are shown and new lines have been added. Send for your copy.

The Complete Line of Wiring Devices

THE ARROW ELECTRIC CO.

HARTFORD, CONNECTICUT

Please send me a copy of the ARROW CATALOG No. 23.

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The Kaffir's test of character, stamina and integrity is the meal (chota hazri).

The fellow with the biggest appetite gets the important post.

Thus a man's job is reached through his stomach.

And we've noticed that sometimes the operators of electric machines try to qualify in similar manner.

They equip their machines with a heterogeneous medley of nondescript carbon brushes and after they've had a belly full of the troubles that such a conglomeration superinduces they feel that they've qualified for an important change.

And THEY *have!!*

They've qualified for an engineering prescription of Morganite Brushes.

Morganite Brush Co., Inc.

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That's the difference between moving a car loaded with 50,000 pounds on a level track one foot with a Samson Rail Gripper Car Mover and moving the same car one foot with a crew of men and a crow bar—the important reason for the present wide use of the Samson Car Movers.

The Samson Rail Gripper is backed by thirty years of service to industry. Made by the first and oldest manufacturers of wood handle car movers in the world. It will pay you to get a Samson today. *Your dealer can supply you.*

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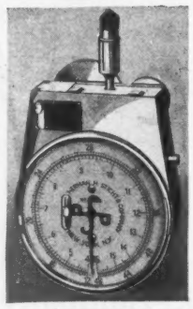
Samson RAIL GRIPPER

POCKET SIZE TACHOMETER



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Size: $1\frac{1}{2}$ inch high and $3\frac{1}{16}$ inches long.
Weight: 10 ounces.
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Accessories: Duplex rubber and steel point and two discs.
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Oil used for 17 years, with annual replenishments, of course, but no evident loss in lubrication value—that, in a word, is the experience of an eastern power plant using Bowser filters.

Analysis by chemists told this story:

The specific gravity Baumé is a shade higher, the flash point 5 degrees higher, the fire point 15 degrees higher, the viscosity 5 seconds more than the three wholly new samples tested for comparison, and the cold test the same.

This is a splendid example of Bowser filtration service, and we welcome such facts and figures to corroborate thousands of similar experiences. Indeed, in every line of endeavor today Bowser filtration system is doing its full part to maintain entire lubrication efficiency.

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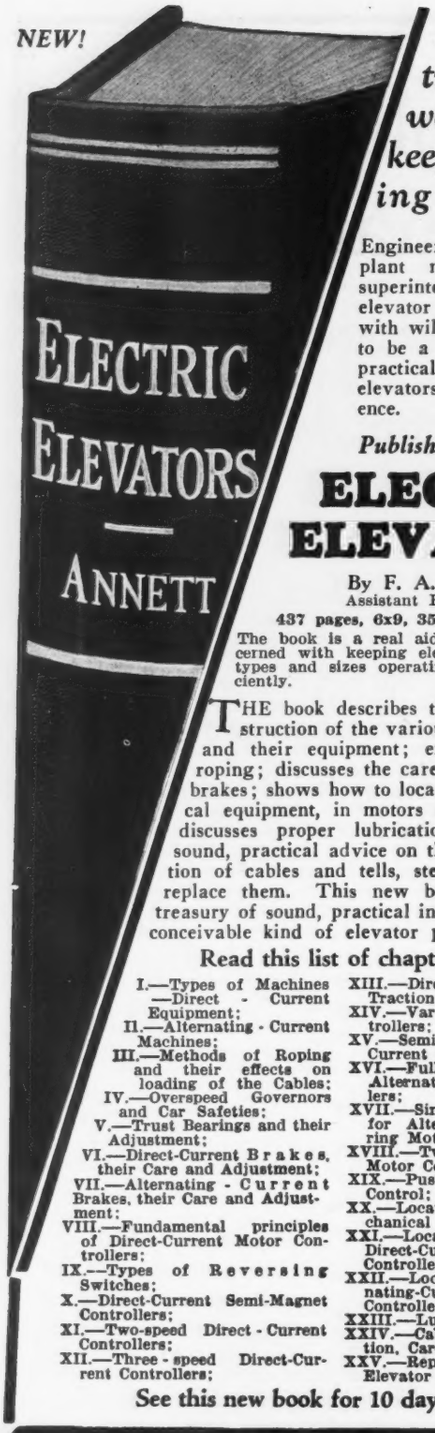

---how electric elevators work—how to keep them working efficiently

Engineers, electricians, power plant men, and building superintendents who have elevator problems to contend with will find this new book to be a thorough, eminently practical manual on electric elevators for study or reference.

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ELECTRIC ELEVATORS

By F. A. ANNETT
Assistant Editor, Power

437 pages, 6x9, 351 illustrations, $5.00

The book is a real aid to all who are concerned with keeping electric elevators of all types and sizes operating smoothly and efficiently.

THE book describes the design and construction of the various types of machines and their equipment; explains methods of roping; discusses the care and adjustment of brakes; shows how to locate faults in mechanical equipment, in motors and in controllers; discusses proper lubrication methods; gives sound, practical advice on the care and inspection of cables and tells, step by step, how to replace them. This new book is a veritable treasury of sound, practical information on every conceivable kind of elevator problem.

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IV.—Overspeed Governors and Car Safeties;
V.—Trust Bearings and their Adjustment;
VI.—Direct-Current Brakes, their Care and Adjustment;
VII.—Alternating - Current Brakes, their Care and Adjustment;
VIII.—Fundamental principles of Direct-Current Motor Controllers;
IX.—Types of Reversing Switches;
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XXI.—Location of Faults in Direct-Current Motors and Controllers;
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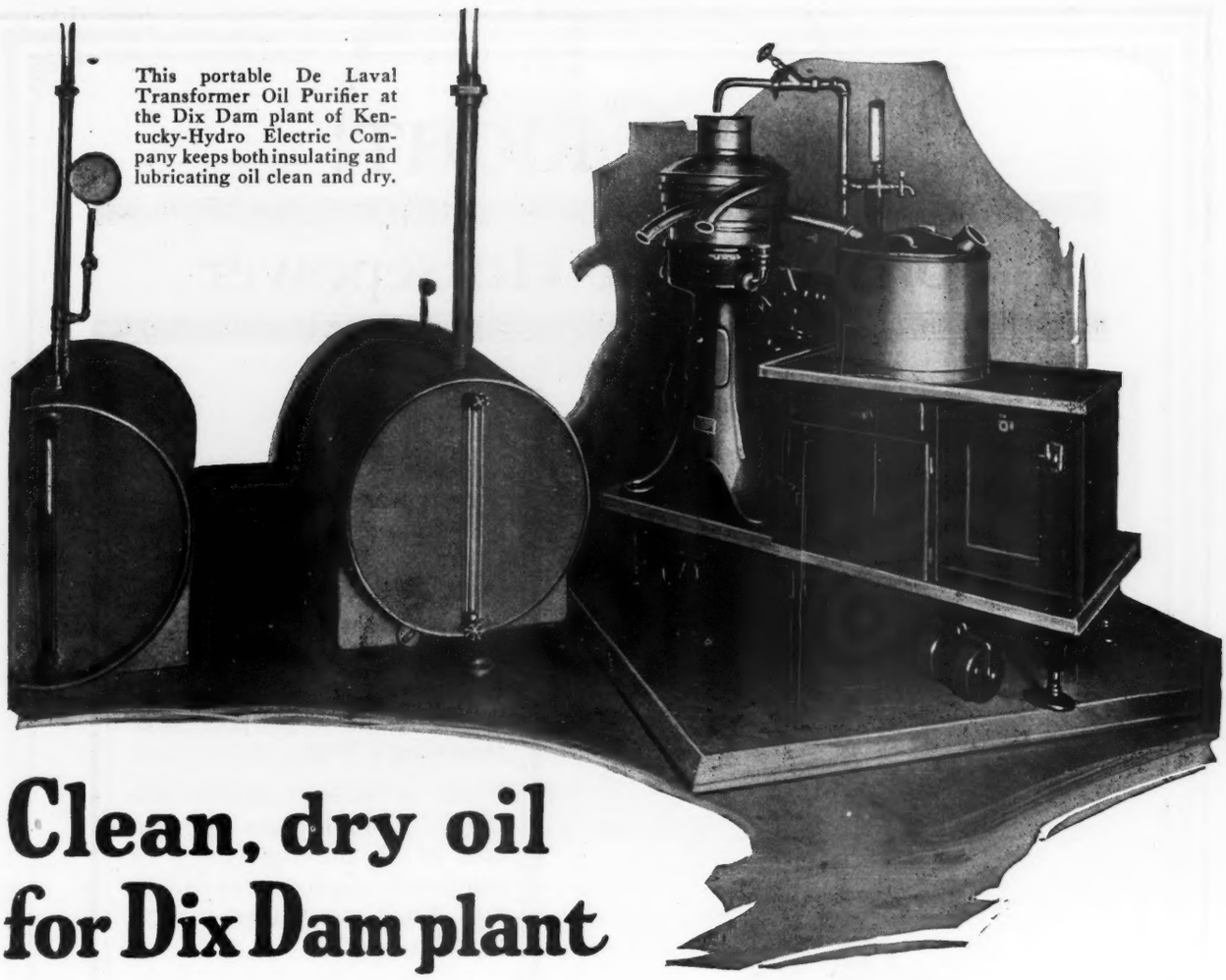

This portable De Laval Transformer Oil Purifier at the Dix Dam plant of Kentucky-Hydro Electric Company keeps both insulating and lubricating oil clean and dry.

Clean, dry oil for Dix Dam plant

Oil used at the Dix Dam plant of the Kentucky-Hydro Electric Company is maintained at high efficiency by means of the portable De Laval Transformer Oil Purifier shown above. A good part of the time the machine is operated as a stationary unit in the oil room, but it is a simple matter to move it alongside a transformer or oil circuit breaker which needs dehydrating, or for that matter, to take it to another plant miles away.

Here as in hundreds of other plants it has been shown that a De Laval enables oil to be maintained at the highest degree of purity at much less cost and with much less trouble than is otherwise possible, for centrifugal dehydration is positive and rapid and does not require the services of an expert.

In most industrial plants there are other oils which can be purified by the same machine with two-fold economy—improved lubrication and lower oil consumption.

We shall be pleased to tell you how a De Laval will soon pay for itself in your own plant. In writing please ask particularly for Bulletin 106-I on lubricating and fuel oil or Bulletin 107-I on transformer and circuit breaker oil.

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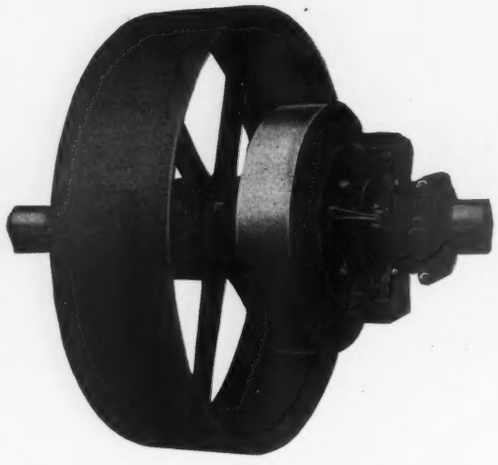
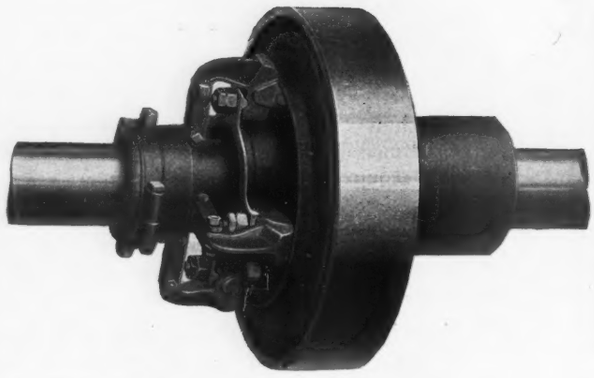
De Laval Oil Purifiers

Types for Lubricating Oil, Fuel Oil, Transformer and Circuit Breaker Oil, Crankcase Oil

DRIVE RIGHT!

Control Your Horsepower





Control your developed horsepower as you do your automobile—with a Friction Clutch—only make certain it is a "UNIVERSAL GIANT."

With it you can start or stop any one or all of your machines at will and without shock by the simple process of throwing a lever.

As a safety device the "U.G." Clutch gives full control of all moving shafts or machines. Costly shut-downs and their consequent delays may be avoided.

Builders of machine tools are incorporating the "U.G." as standard equipment in their product.

It will pay you to investigate the "U.G.", there will be no obligation.

SEVENTY YEARS of SERVICE
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POWER TRANSMISSION MACHINERY
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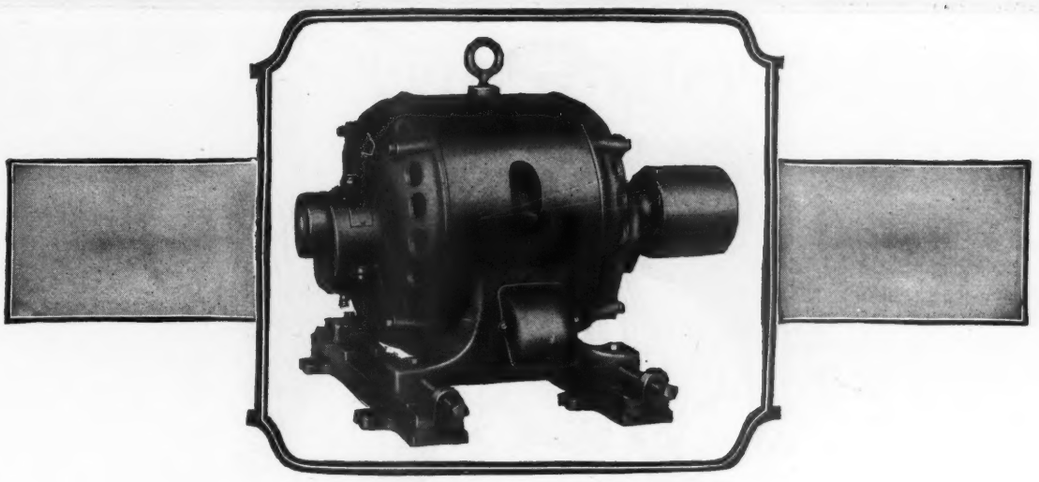
Rope Drives	Speed Reducers
Friction Clutches	Conveyors

Ball Bearings



7½ Horse Power Century Type SC Squirrel Cage Induction 3 and 2 Phase Motor

Continuity of Service

The long, uninterrupted service which users of Century Type SC Squirrel Cage Induction 3 and 2 Phase Motors experience, results from liberal proportions, with proper mechanical and electrical design and allocation of active materials.

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2 . . Bearings last under severe service. They are made from cast phosphor bronze, machined to micrometer limits—and provided with machine-cut figure-8 oil grooves.

3 . . Field coils withstand the dampness of humid, tropical climates because they are insulated with moisture resisting material and the completed winding saturated with insulating compound.

Century Type SC Squirrel Cage Induction 3 and 2 Phase Motors are built in all standard sizes from ¼ to 75 horse power. Under normal operating conditions temperature rise is not more than 40° Centigrade.

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33 Stock Points in the United States and More Than 50 Outside Thereof

"They Keep ¼ to 75 H. P.

Century MOTORS

a-Running" ¼ to 75 H. P.

No job is better than the wire that forms its foundation

POOR wire never yet made a good wiring job. No matter how expertly the work is done, if the wire isn't *right* the whole installation suffers. Someone is likely to be blamed for "faulty wiring" when the true trouble is *faulty wire.*

That's why contractors, industrial engineers, architects—all who specify and use rubber covered wires—insist on PARANITE. When a business reputation is at stake it isn't prudent to gamble with wire.

Into every roll of PARANITE we've built 37 years of experience and experiments. And back of it all, is an unrelenting determination to make our product increasingly better. That's why PARANITE stays always a pace ahead of the procession.

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IN selecting equipment for the new Wrigley Building, much was gained through the experience with equipment in the old building. Morse Silent Chain Drives were used on the water pumping system and "although they have been in service constantly, there has never been either a breakdown or one cent spent on repairs."

Further the report says, "Two Morse Chains are used on the two 15 H.P. motors that drive the 7 x 8 pumps which serve the main building—and two on the 7½ H.P. motors that drive 4 x 8 pumps for the towers. Each chain is subjected to the short heavy pull and sudden start on the average of 4 times an hour or 72 times for the 18 hours a day operated."

Doubtless there are power transmission and speed reduction problems that Morse Silent Chains can solve for you.

Consult the nearest Morse Transmission Engineer.

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15 hp. Morse Silent Chain Drive from Motor to House Pump, Wrigley Building, Chicago, Illinois. Driver, 850 r.p.m., Driven, 35 r.p.m.

Morse Engineers are always available at

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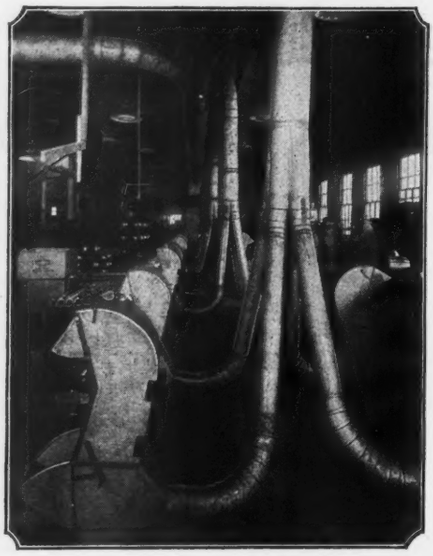

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The better design of K & B blower systems pays dividends in production in metal working shops.

For example, the overhead suction line in the C. M. Hall installation makes it easy to provide convenient aisleways between machines. Substantial one-piece machine-made elbows and durable piping construction withstand vibration and occasional bumps from hand trucks without damage. Cluster fittings make a neat, space-saving installation and adjustable hoods with hinged sides permit the worker to set the hood for efficient dust-removal and convenient handling of the work or to make wheel changes quickly.

Blower construction like this means a clean plant and satisfied workers, with consequent boosting of output per dollar of payroll.

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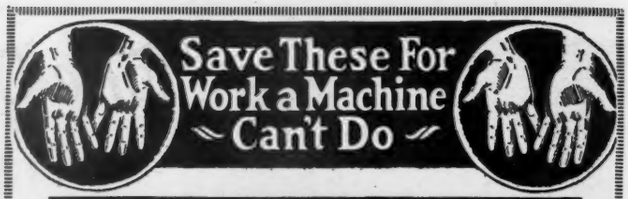

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The Outstanding Machine Tool Development In the Past Decade

THE insistent demand for better-than-hand-work, at a speed that greatly exceeded it, gives Haskins Flexible Shaft Equipment the justly deserved opportunity of demonstrating that there are hundreds of special operations where it is faster and easier—THEREFORE MORE ECONOMICAL—to Take-The-Tool-To-The-Work.

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Portable Flexible Shaft Machinery

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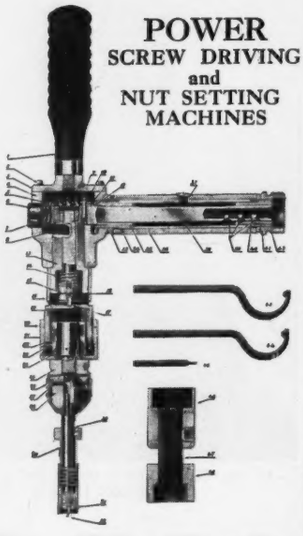
NUT SETTING **Strand** SCREW DRIVING
FLEXIBLE SHAFTS



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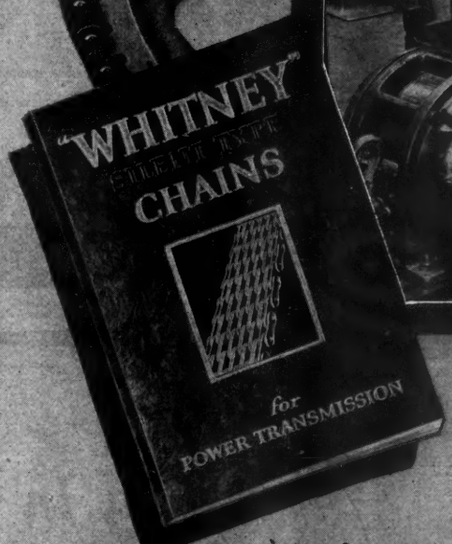

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are available for practically any power transmission to which chains are adaptable.

EFFICIENT DURABLE ECONOMICAL

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The unanimous verdict of leather experts all over the world is that mineral tanned leather is more durable than vegetable tanned.

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Long Life is Built In

"LENOX" Screw Drivers are forged in one piece from handle to tip, of the highest quality special analysis steel.

Points are heat treated to stand the strain without bending. And the handles cannot loosen.

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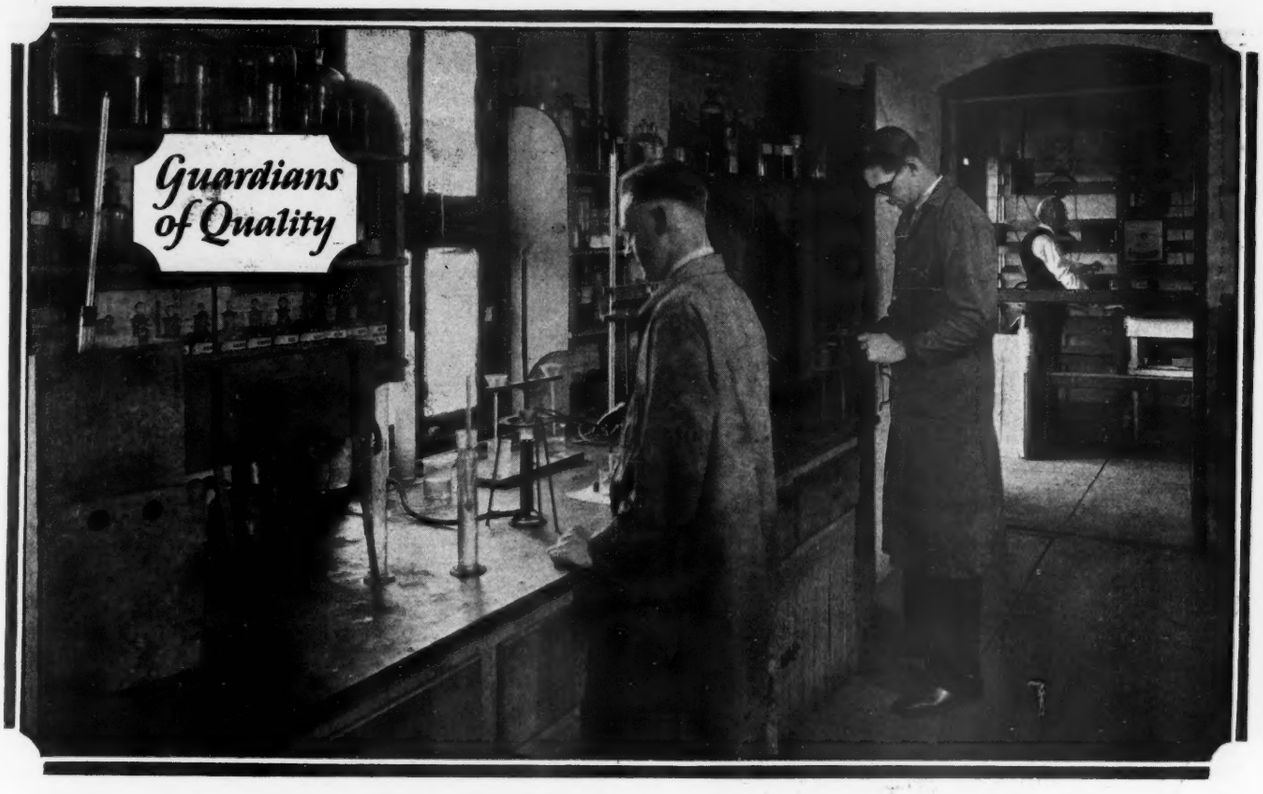
Springfield, Mass.
"The Tools in the Plaid Box"



Standardized testing
—*an assurance of uniform high quality*

Throughout the process of manufacture, all raw materials, every product used in producing Micanite and Empire insulations, as well as the finished insulations, are tested in strict accordance with the standards of the American Society for Testing Materials.

That is why the electrical, physical and chemical characteristics of Micanite and Empire are always uniform and dependable.

Standardized testing is but one phase of the modern scientific manufacture that produces "the always dependable insulation." Empire and Micanite mean assured quality.

MICA INSULATOR COMPANY

World's Largest Manufacturers of Mica Insulation

Sole Mfrs. of Micanite, Super and Empire Electrical Insulation

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PERFECT MICANITE INSULATOR REG. U.S. PAT. OFF.

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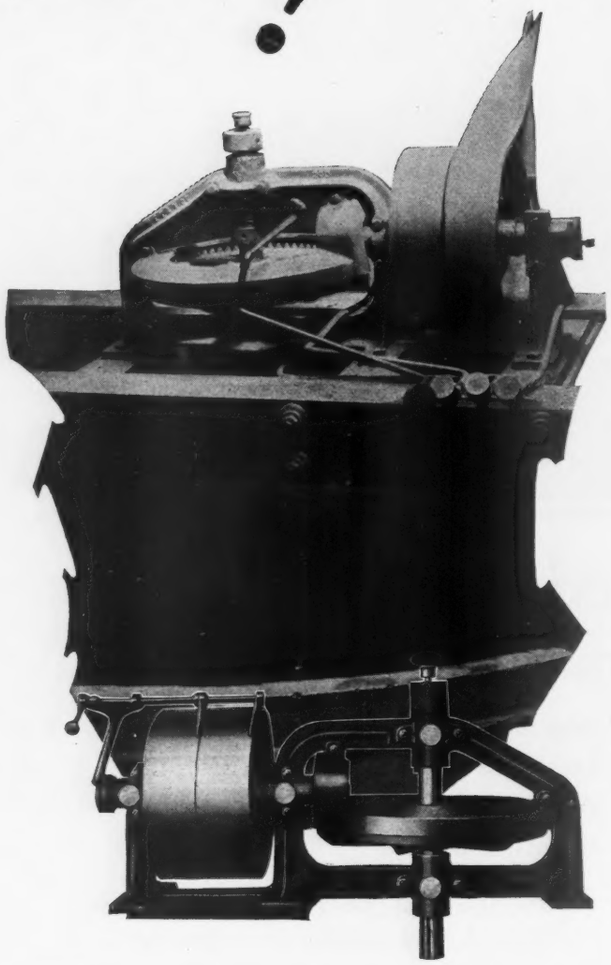
PERFECT EMPIRE INSULATOR REG. U.S. PAT. OFF.

MICA INSULATION OILED CLOTH INSULATION

a standard unit for every purpose!



Agitator drives that are adaptable to almost any special requirement may be selected from the "New England" or "Nett-Co" line—there's economy in using these Standard drives.

Send for complete information about them.

NEW ENGLAND (enclosed) & NETT-CO. (open)

Agitator Drives

NEW ENGLAND TANK & TOWER CO.
EVERETT, MASS.
30 Church St. New York

Dependable MOTORS

D. C. and A. C. Motors from $\frac{1}{4}$ H. P. up.
D. C. and A. C. Generators and Motor-Generator Sets from 100 Watts up.

CROCKER-WHEELER ELEC. MFG. CO.
Ampere, N. J.
Birmingham Boston Buffalo Chicago Cleveland
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SPEED REDUCERS

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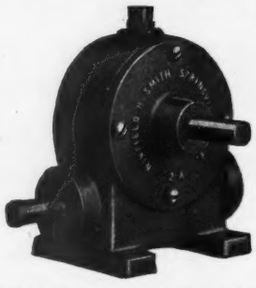

For Motors up to 5 H.P. Capacity

Catalog on Request.

WINFIELD H. SMITH, Inc.
15 Eaton St., Springville, Erie Co., N. Y.

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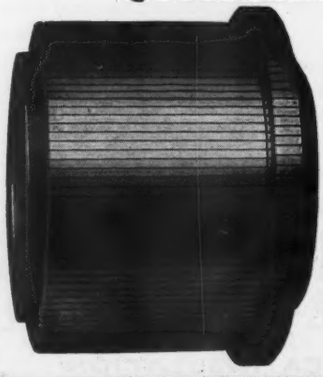
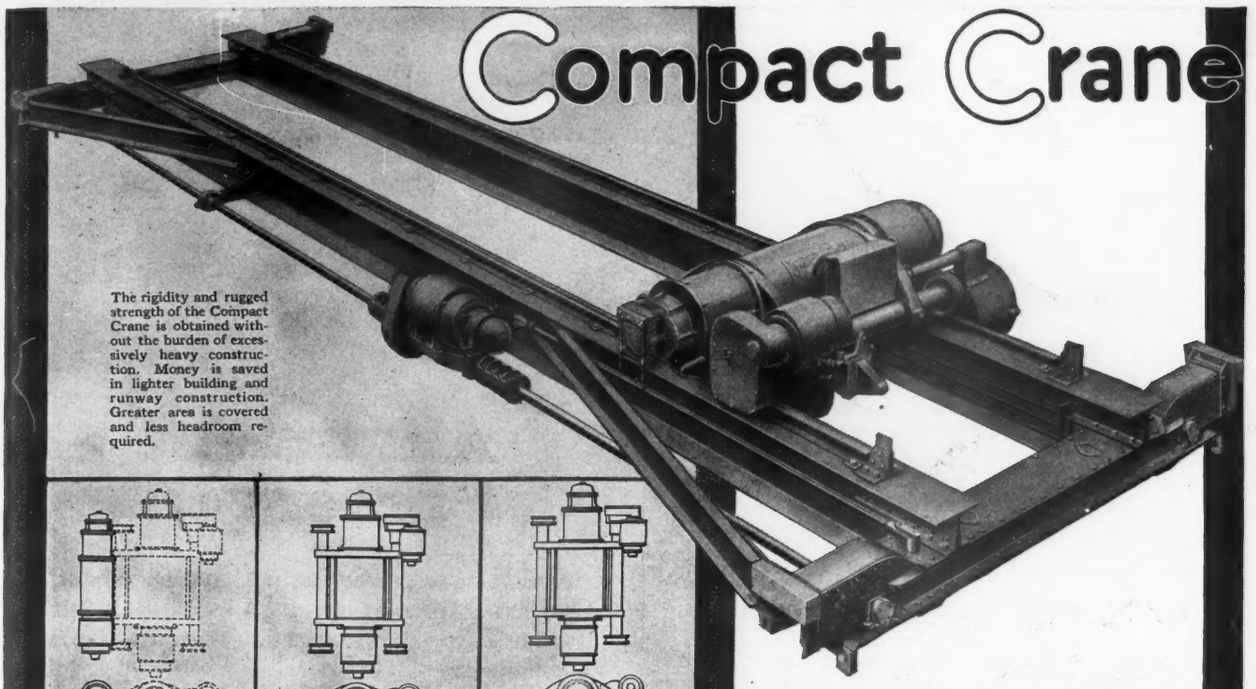


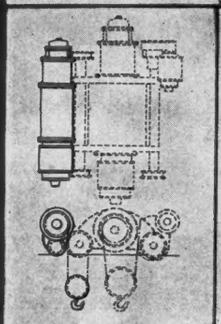
Commutators refilled with hard drawn copper to your specifications within a few hours after receipt of core and sample bars.

Cleveland Armature Works, Inc.
E. 49th & St. Clair Ave.,
Cleveland, O.

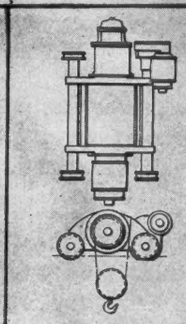
Compact Crane



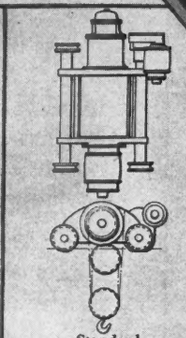
The rigidity and rugged strength of the Compact Crane is obtained without the burden of excessively heavy construction. Money is saved in lighter building and runway construction. Greater area is covered and less headroom required.



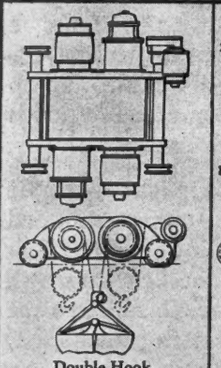
Auxiliary Hoist
can be attached to any Shepard Crane Trolley



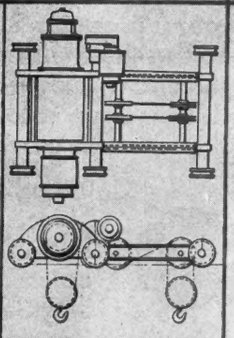
Standard
1 and 2 part double reeving, for many general purposes.



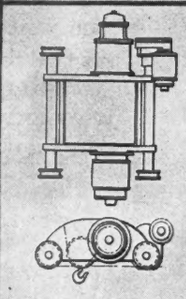
Standard
3 and 4 part double reeving. Extra long drum furnished for long lifts.



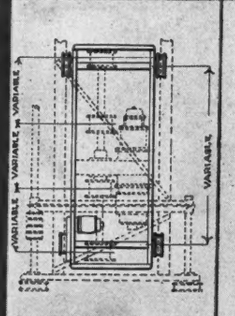
Double Hook
2 hoisting units of equal capacity, for grab buckets and double hook service.



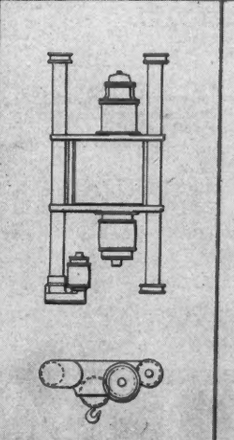
Extension
2 hooks for lifting simultaneously at two points long loads parallel to crane girders.



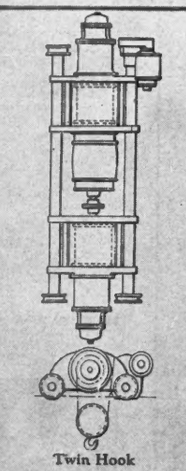
Close Lift
Permits hook to come close to trolley rail.



Submerged
Runs between and on the lower flanges of two I-beam girders.



Close Clearance
Permits location of trolley rail close to ceiling or roof.



Twin Hook
Two drums and two hooks operating simultaneously and at right angles to trolley rail.

with a trolley specially suited to each job

–minus a special job price

A Compact Crane Trolley has unusual strength and rigidity. The load carrying frame is all steel construction. The girts are box section steel castings, connected by a body piece of wrought steel plate, securely riveted or welded and amply braced on the underside. Axle brackets of heavy seamless drawn steel tubes carry the frame.

A sectionalized design affords a trolley arrangement to suit precisely your plant and load-moving conditions—a few of the many adaptations are shown.

Let a Shepard representative explain fully the advantages of this unique design and its economy.

SHEPARD ELECTRIC CRANE & HOIST CO.
415 Schuyler Ave., Montour Falls, N. Y.

SHEPARD
ELECTRIC CRANES & HOISTS

Largest Manufacturer of Electric Hoists in America

Branch offices are maintained in principal cities

when you are "on the fence!"

—not quite sure whether to send that order for electrical parts to EUREKA or somewhere else—

Then just think of this:

Many of our shipments are made in just about one-quarter the time that our customers expected to wait. That's what they tell us.

Our workmanship and materials are of highest quality— all work guaranteed. Prices are always reasonable.

So when you're "on the fence," try EUREKA for Commutators, Commutator Bars. Brush Holders, either standard or special. Copper leaf and Gauze Brushes. Collector Rings and Soles. Controller fingers, segments, field plates, etc. Trolley wheels, Collector wheels, etc. Bearings and Bushings. Line Material. Switches. Copper and brass washers and nuts. Copper hammers, etc.

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EUREKA COPPER PRODUCTS CORPORATION

79 Clay Street, North East, Pa.

"You'll say EUREKA!

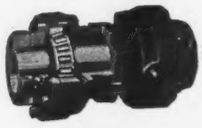
I've found it: Prompt service, high grade electrical parts, and reasonable prices."

The MEDART Timken Equipped Pillow Block

Alignment Preserved

In addition to preserving positive alignment, Medart Timken-equipped Spherical Ball and Socket Pillow Blocks provide these desirable advantages:

They save power and lubricant... Practically eliminate wear... Are economical, particularly in duplicate machinery... Can be modified to suit almost any engineering or structural requirements... The appliance comes to the user filled with lubricant... Bearings are permanently and properly set up... Can be applied to the shaft without disturbing the working elements, simply by clamping up two bored steel clamping collars... No sleeve threads to weaken the structure.



The Ball and Socket Hanger Bearing

—when applied in either Medart post or drop hanger frames for support of line shafting, takes out the heavy drag. Saves lubricant, wear, fuel, power.

Other appliances in the Medart Timken-equipped Line of Industrial Applications are [1] The Ball and Socket Hanger for line shafting usage, [2] The Unit Mounting adapted to use in individual machines, and [3] The Loose Pulley.

This added Line makes Medart a more complete source for mechanical power transmitting machinery and allied products than at any time in its nearly 50 years of serving Industry... Ask for Bulletin on Timken-Equipped Line and for Catalog No. 43 on all other Medart Transmission Equipment.

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(Formerly Medart Patent Pulley Co.)

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MANUFACTURERS OF POWER TRANSMITTING AND KINDRED MACHINERY

MEDART

Everything in Line Shafting Equipment

New Nuttall Speed Reducers

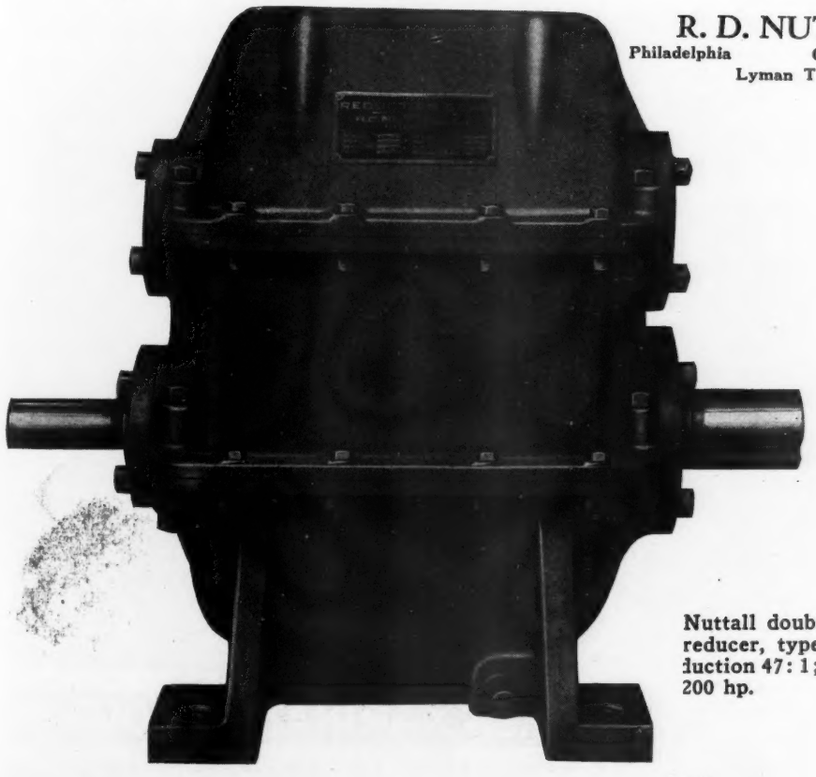
Helical Gears
Timken Roller Bearings
Positive Lubrication

The new Nuttall helical gear speed reducers are simply and ruggedly constructed. They have but few parts to wear and get out of order. They are built to operate continuously, and even under the most adverse conditions to require no attention beyond the occasional addition of oil to the case.

Helical gears give great strength and smooth operation; Timken roller bearings insure bearing dependability; the rigid reinforced case assures perfect alignment of shafts and gears even under great stress; and the Nuttall system of positive splash lubrication reduces maintenance to the very minimum.

Send for our Speed Reducer Bulletin

R. D. NUTTALL CO., Pittsburgh, Pa.
Philadelphia Chicago Wilkes-Barre Los Angeles
Lyman Tube & Supply Co., Montreal, Canada



Nuttall double reduction speed reducer, type DVR. Max. reduction 47: 1; Max. horse power 200 hp.

Nuttall

This library answers all the repair and winding problems that the electrician will meet in actual practice

THESE five volumes contain the largest collection of practical methods for electrical repair and maintenance men ever put together in book form.

The books cover every phase of electrical repair and maintenance work from armature winding to the correction of brush troubles. And the treatment is always from the practical man's standpoint.

These five books will help the young repairmen to absorb knowledge that could be secured otherwise only through many years of experience.

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5 Volumes—1736 pages—1810 illustrations—7c. a day

EVERY man concerned with the care and repair of electrical machinery should have these practical books, with their helpful tables, diagrams, data, methods and kinks.

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In these books will be found answers to practically all the repair and winding problems that the electrician will meet in actual practice.

Every phase of electrical maintenance and repair work covered

The books discuss direct and alternating current windings —repair shop methods for rewinding armatures—commutator connections—the testing of armature windings—the testing of induction motors for faults—practical ways of reconnecting induction motors—commutator repairs—correcting brush troubles, etc.

They tell you how to inspect and repair motor starters and generators—how to diagnose motor and generator troubles —how to figure new windings for old cores on induction motors.

You learn about three-wire systems, starting rheostats, transformers and starting polyphase motors, etc.

They give you scores of practical methods used by electrical repairmen to solve special problems.

The books contain hundreds of photographs, diagrams and tables. There are wiring diagrams covering A. C. and D. C. generators, feeders, transformers, potential regulators, synchronous converters, batteries and boosters, substations, lamp mechanism connections, rheostats and controller, lightning arresters, automatic switches, railway controllers, etc.

Practical how-to-do-it books

The five volumes in this library are how-to-do-it books in every sense of the word.

They deal with the everyday work of electrical maintenance and repair.

They discuss actual repair jobs and show you, step by step, what to do when anything goes wrong.

They show you how to locate and remedy motor and generator troubles.

They show you how to reconnect motors to meet any condition of voltage, phase, frequency and speed.

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They cover fully the rewinding of motors.

They present information that will help you get better service out of electrical equipment and machinery.

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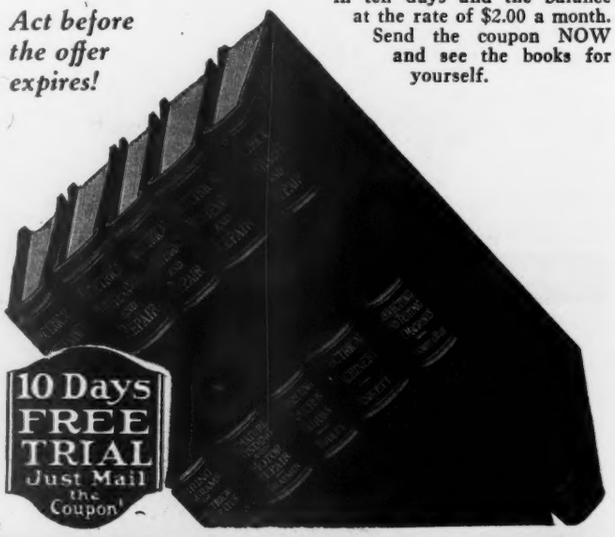

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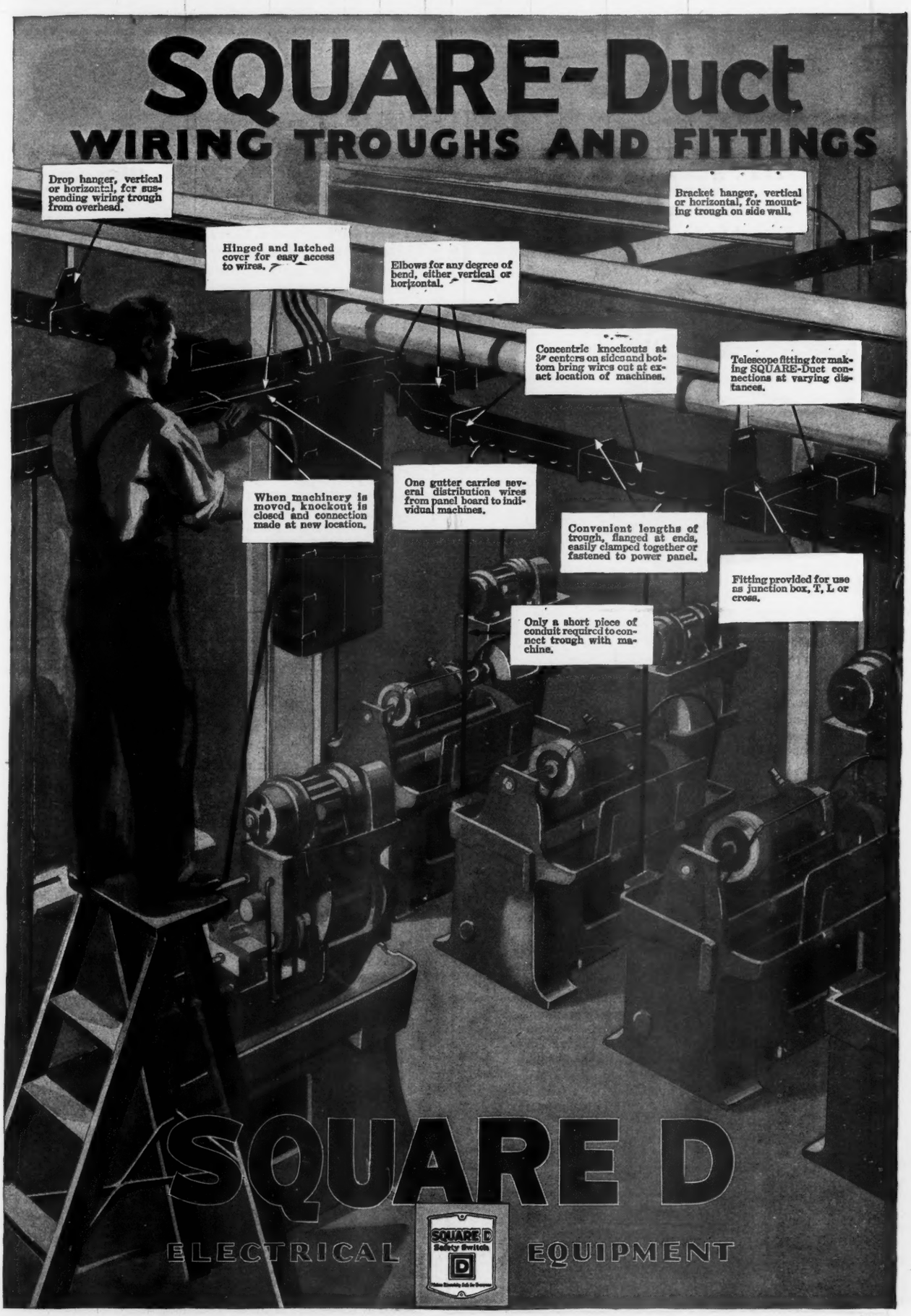
SQUARE-Duct
WIRING TROUGHS AND FITTINGS
Drop hanger, vertical or horizontal, for suspending wiring trough from overhead.
Bracket hanger, vertical or horizontal, for mounting trough on side wall.
Hinged and latched cover for easy access to wires.
Elbows for any degree of bend, either vertical or horizontal.
Concentric knockouts at 3" centers on sides and bottom bring wires out at exact location of machines.
Telescope fitting for making SQUARE-Duct connections at varying distances.
When machinery is moved, knockout is closed and connection made at new location.
One gutter carries several distribution wires from panel board to individual machines.
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Fitting provided for use as junction box, T, L or cross.
Only a short piece of conduit required to connect trough with machine.
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SQUARE D
Safety Switch
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EQUIPMENT

(178)

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MASTER

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Jewell "Master" Portable No. 172

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It has a—

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—Hand drawn scale.
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—Series resistance placed in separate ventilated compartment.

Each of the above features is of real advantage to the user of instruments because—

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—hand drawn scales have cardinal points stepped directly from the movement with which it is to be used. The instrument remains accurate.
—non-shatterable glass in the scale opening prevents danger of damage to movement from broken glass as in ordinary instruments.
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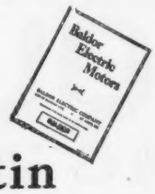

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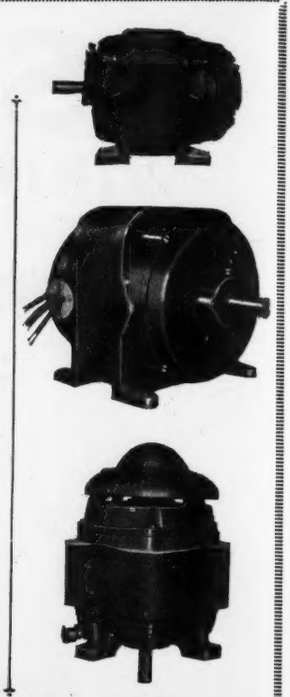

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A BETTER MOTOR

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Coil making machines offer the latest in modern equipment for coil making.
Our machines are the simplest and less expensive and are being used by thousands of concerns throughout the world.
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Bleachers, Dyers and Mercerizers of Cotton Yarns and Warps
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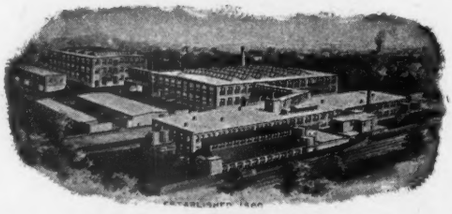

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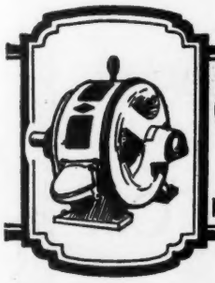

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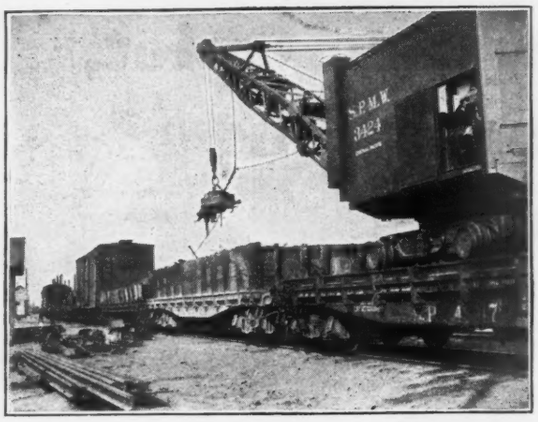
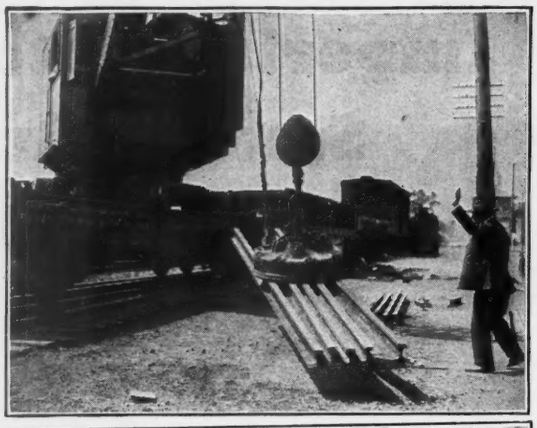
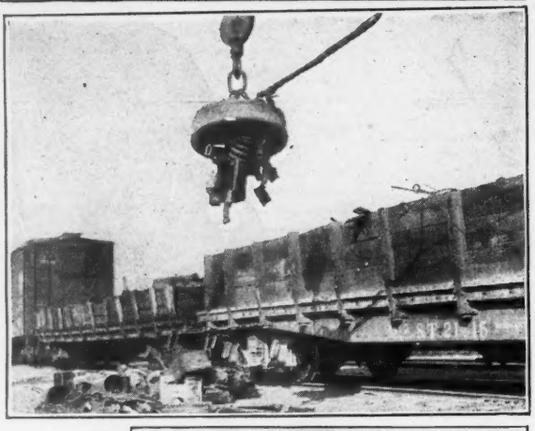
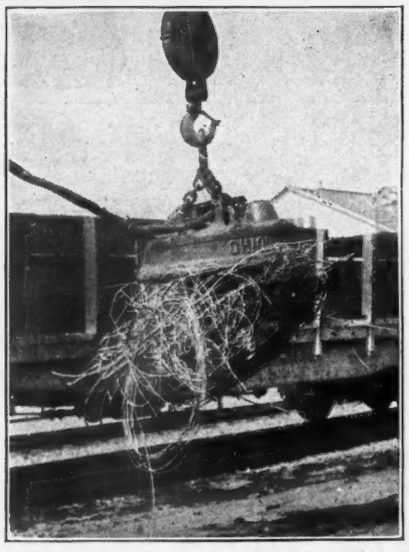








These pictures show a 36" diameter Ohio Magnet handling a variety of materials from wire to steel rails easily and with no complaint if worked 365 days (of 24 hours) per year.

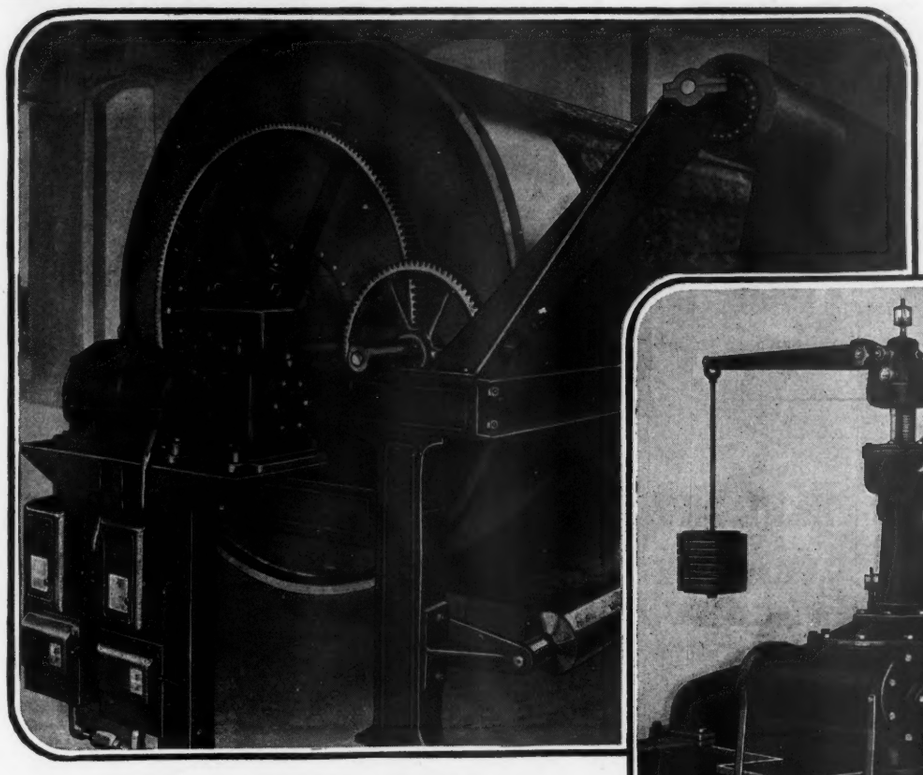
The magnet automatically rejects any copper, brass or babbit which can then be collected and sold at appropriate prices.

Ohio Magnet Outer Rings are solid, they very seldom break. All insulation is asbestos. Upkeep cost is very low.

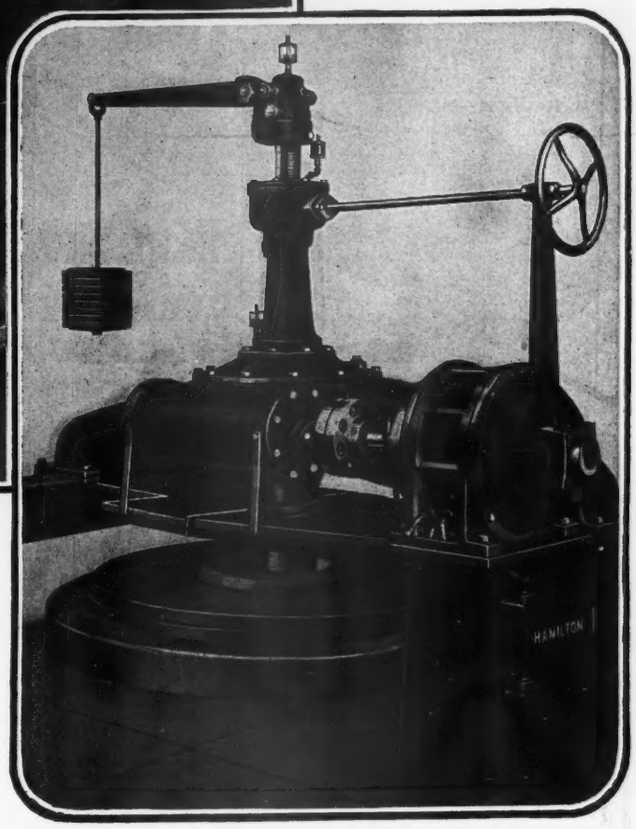
Have you a Magnet Problem?

OHIO reliable MAGNETS

The
Ohio Electric & Controller Co.
5910 Maurice Ave.
Cleveland, Ohio



Below: Standard Cleveland Worms and Gears are furnished in this grinder head for a plate glass finishing machine. Ratio 33½:1, 20 hp., 865 r.pm. Each machine is equipped with twenty-five of these heads.



Above: Standard Cleveland Worm Gear Reduction Unit built into the drive of a carpet steaming and drying machine. Ratio 8¾:1, 5 hp., 1,200 r.p.m.

Cleveland Worm Gear Drives for Your Special Machines

Cleveland TRADE MARK CWGC WORM GEAR REDUCTION UNITS

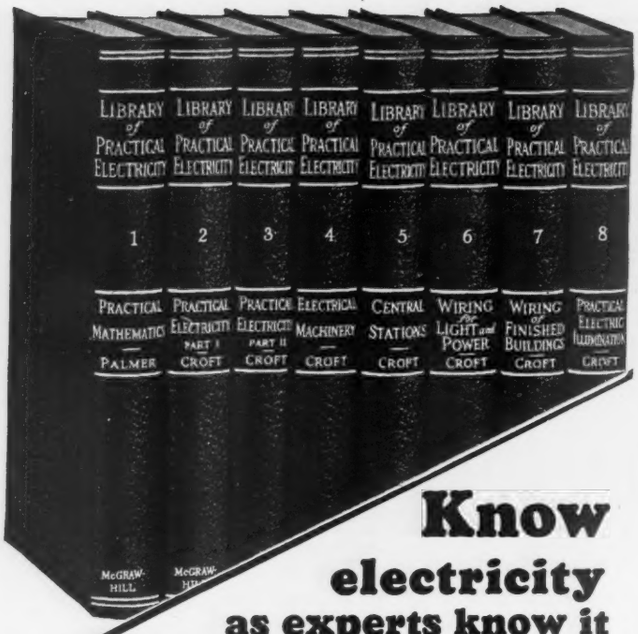
The standard Cleveland Worm Gear Reduction Units are described in Bulletin No. 106. *Send for your copy.*

A dependable drive is a major requirement for special production machinery. The Cleveland worm gear drive eliminates production delays and reduces maintenance attention and cost to an absolute minimum. Standard Cleveland worm gearing can be built into the housing of the machine or a standard enclosed reduction unit can be incorporated in the design. Both arrangements are illustrated above. It will pay you to consider the Cleveland worm gear drive for your next special equipment.

"Cleveland Worm Gearing—the Ultimate Drive"

CLEVELAND WORM & GEAR COMPANY

3268 EAST 80th STREET CLEVELAND, OHIO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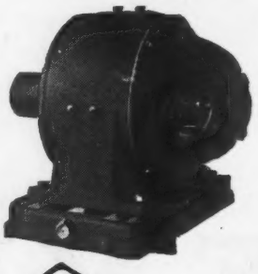

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D. C. and A. C. MOTORS

Require only a minimum of servicing. Have unusually long life. Help maintain maximum production.

D. C. Machines up to 75 H.P. with commutating poles. Get Bulletin No. 200.

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Built to a Standard

Marble-Card Electric Company
Gladstone, Michigan

Lad talks in parables.

"Here, Lad—

you claim that the Lincoln people have hit on a wonderful idea in motor construction. How come that something new in a motor, one of the oldest and most thoroughly developed pieces of electrical apparatus, should so suddenly be discovered?"

"Easy, Pop—

stockings were invented in the eleventh century but they weren't discovered until the twentieth.

There have been too many cast iron petticoats on motors in the past—all following a rigid fundamentalism in design.

The Lincoln people in this 'Linc-Weld' motor got rid of cast iron construction—put in muscular shafts and masculine bearings to keep down bearing troubles—piled in plenty of active materials and better insulation. But they didn't make a new motor—just made it according to modern principles with a betterment of the older principles—pulled out the cast iron petticoats that warmed up the old motors—put in welded steel which let in the air.

In other words, they gave the motor a chance to step—with pep."

The Lincoln Electric Co., Dept. No. 5-12, Cleveland, Ohio

M-1

LINCOLN MOTOR
"Linc-Weld"

This means a lot to all readers yet many will pass it up - - - !

MANY will send for this data, yet there is always a percentage who pass up chance after chance to learn how others profit. The largest industrial organizations in the country have materially cut their costs for:

1—New Wiring
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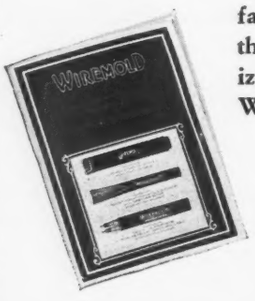
thru the logical, and intelligent use of Wiremold Surface Wiring Systems. Contractors, Architects, and Electrical Engineers appreciate the economy of Wiremold Systems.



You, too, should be thoroughly familiar with the reasons why thousands of industrial organizations are large users of Wiremold. These include:

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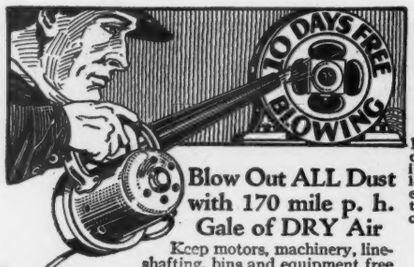

Blow Out ALL Dust with 170 mile p. h. Gale of DRY Air

Keep motors, machinery, line-shafting, bins and equipment free of harmful dust, dirt, lint, etc. Fastest, safest, cheapest method. 170 mile per hour gale of CLEAN, DRY air reaches everywhere—no condensed moisture. No tank, no heavy hose to drag about. Unless 10 days' use satisfies, don't buy.

Blow all dust and dirt from line shafting, in less time at less cost. Save power—eliminate friction caused by accumulation of dust.

BREUER'S BALL BEARING TORNADO PORTABLE ELECTRIC BLOWER

Blow all dust, dirt, lint, etc., from machinery, motors, generators, etc. Save repairs, shutdowns. Add years to life of plant equipment.

Weighs 7 lbs. Connects to any socket. Super powerful—delivers more air with more force. ½ h. p. G-E motor. Ball bearings—no oiling. Lessen fire risks, save repairs, shutdowns. Suction or spraying attachments if desired. Guaranteed to do the work where others fail. Costs no more—soon pays for itself. Product of 20 years' electrical manufacturing experience. Write for Free Trial Offer.

Greater power proved! "Tornado" floats rubber ball *twice* as high as other blowers.

Suction cleaning attachments quickly suck dust and dirt out of bins, machines, motors, auto upholstery, etc.

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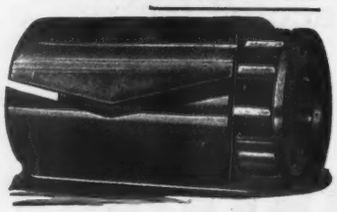

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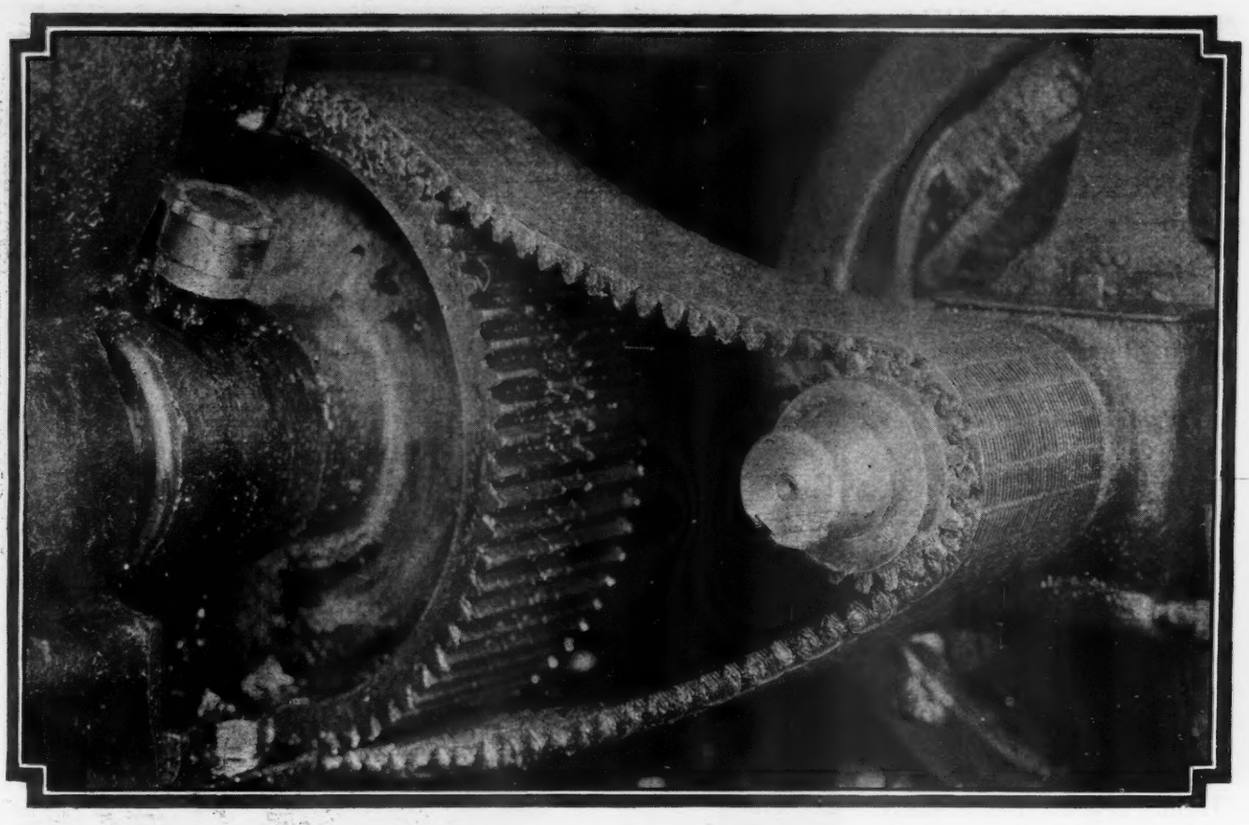

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With Ramsey Silent Chain Drives

THE quality, quantity and cost of the work done in your plant depends, to no small degree, upon the performance of your power transmission equipment.

Accordingly, improved power transmission has far-reaching possibilities.

Many industrial plants have realized such possibilities — increased output, more service on cutting tools, better finish, saving on power bills, lower production costs—through the installation of Ramsey Silent Chain Drives.

The secret of Ramsey Chain Drives' fine performance is the frictionless Roller Bearing Joint—an exclusive patented feature—which permits using higher speeds, and lends to Ramsey Chain a quiet smoothness and absence of vibration never before realized with chain drives.

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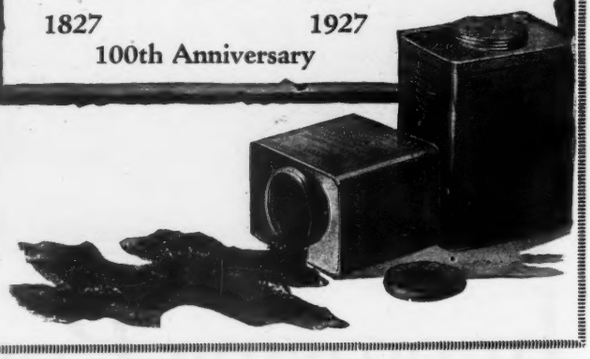

The "key" log holds the jam!

A SINGLE log, one of many thousands, strikes a snag. It falters. Before it can break away, others are checked. Soon the entire run piles up, held back by the one offending log—the "key" log of the jam.

In manufacturing processes, cleaning is often the "key" operation that retards output. Parts caught on the "snag" of inefficient or uncertain cleaning interrupt the smooth flow of production. Subsequent operations are held up. Frequently the output of an entire department is affected.

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Oakite Service Men, cleaning specialists, are located in the leading industrial centers of the United States and Canada

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OAKITE
Industrial Cleaning Materials and Methods

Buy this motor~ *and junk the OIL CAN!*

The oil can and its contents though essential to the ordinary motor are two of its worst enemies. Too much oil carelessly directed causes oil-soaked windings and costly breakdowns.

With Reliance Ball-bearing Motors on the job you can cut out the danger and cut down the cost at the same time. In place of frequent oil squirting apply a little grease once a year. The grease is easily put where it belongs and can be kept there. Breakdowns due to oil-soaked windings are at an end.

The Reliance ball-bearing motor construction is backed by 21 years of experience in applying anti-friction bearings to electric motors.

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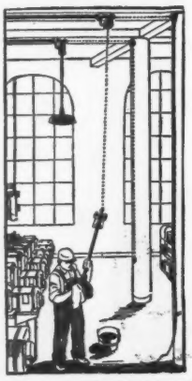
RELIANCE A-C D-C MOTORS
WITH BALL BEARINGS



"Why up in the Air"—

—When reflectors can be cleaned more frequently, safely and thoroughly down on the ground?

They are worthless unless kept in a reflecting condition. Dirty reflectors do not reflect.

Why install a lamp where it cannot be cleaned at all—or only by the climbing process?

The THOMPSON Safety Lowering Switch or disconnecting Hanger enables overhead lamps to be lowered away from the electric circuit for cleaning the reflectors or renewing bulbs. The advantage is obvious. The Hanger is inexpensive and easily included in present installations. For outdoor and indoor use.

Illustrated booklet and complete information on request.

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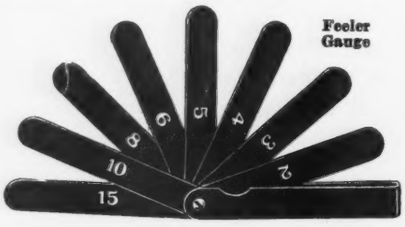
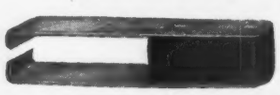
1438 West Ninth St., CLEVELAND, OHIO, U. S. A.

THOMPSON
SAFETY LOWERING SWITCH
or HANGER





The tools that save your time and make your job easier

We carry a complete stock of specially designed tools for the maintenance man. Handy tools that can be slipped into your kit, convenient for the everyday run of jobs that come up. *Check those you would like on the coupon and send it in or write for a catalog.*

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☐ Wedge Driver
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☐ Imperial Commutator Stone—all sizes and handles.

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F-R-I-C-T-I-O-N
that old bogey of power transmission

can be materially reduced—unnecessary power losses can be cut down—with

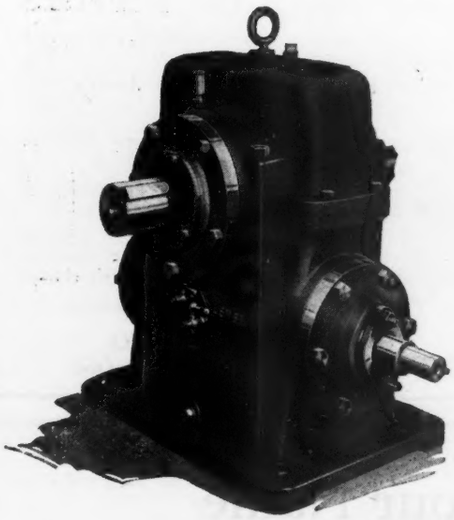
Philadelphia
SPEED REDUCING UNITS

Just to give one example:

Ball or Roller Bearings are used on the shafts of Philadelphia Units and all moving parts operate in an "oil bath." All the gears used have perfect tooth contact and are made from the highest grade materials, specially treated to resist wear.

As all moving parts are completely housed, these units are unaffected by Dirt, Dust, Moisture and Acid Fumes.

And, with these Speed Reducing Units you can use the economical "High Speed" Motors.



NOTE: There's a Philadelphia Unit for every purpose: Worm, Herringbone, and Spur Types; Straight Line, Right Angle or Vertical Drives.

P. S.—We've been making all sizes and types of Gears for nearly 50 years. "Send for the Gear Book."

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Speed Reducers
are the ideal drive for:

Rotary Kilns
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Manufacturers of Industrial Gears and Speed Reducing Units

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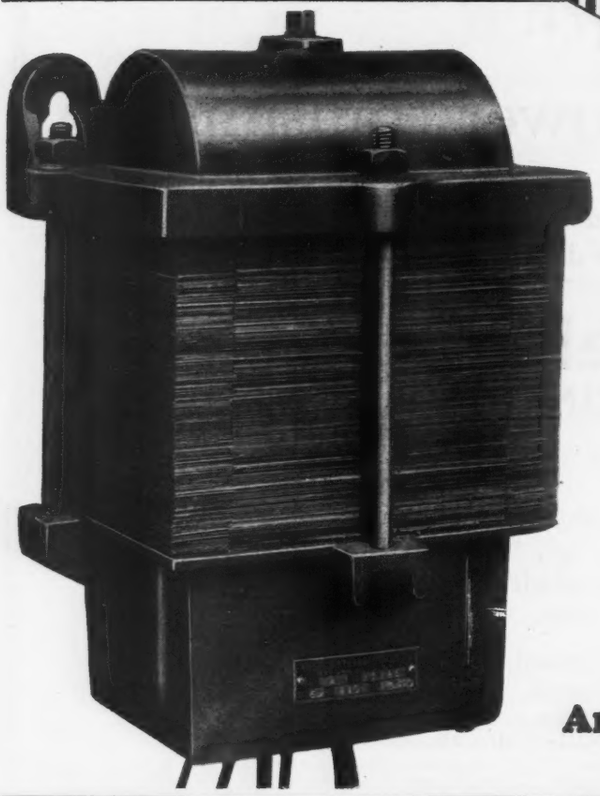
AMERICAN TRANSFORMER



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for

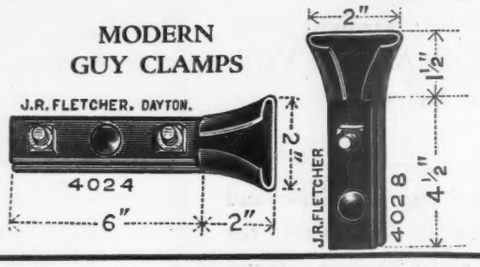
Industrial Lighting and Power
Sign Lighting, Phase Changing,
Electric Welding, Brazing, etc.

This type CF transformer is of the two winding type, the primary being wound for single-phase 220 volt and the secondary for 110/220 volt. It is built in sizes 1 to 5 kva. and is carried in stock for 220 volt, 60 cycle primary. It can be wound for 440 or 550 volts for reasonable quick delivery.

This type CF transformer can be used indoor or outdoor and is exactly what the distribution superintendent and industrial plant electrical engineer require when a double-wound transformer is preferred to an auto-transformer.

Write for Bulletin 1040-I

American Transformer Company
180 Emmett Street, Newark, N. J.



CONSTRUCTION SUPPLIES

We illustrate here a few of the devices which we manufacture. Viz.—

Porcelain brackets with double pointed screws

Spacer Braces and Modern Guy Clamps

The Spacer braces are the best braces that were ever put on the market. They are easily installed and give entire satisfaction.

Our Modern Guy Clamps are very popular. They clamp the cable firmly and are easily installed. Much more so than the old style clamps.

Catalog with full line on application

FLETCHER MFG. CO.
2nd and Canal Sts., Dayton, Ohio

IRVINGTON VARNISH

For Dipping and Baking

Dipping with Irvington Varnish and then baking will make your armatures good for many years' additional service. Prepare now for the heavy overloads of winter time operation. Place that order today. Our nearest sales representative will be prompt in serving you.

Irvington Varnish & Insulator Co.
Irvington, N. J.

Your Name

in this space in all issues where larger display space is not used backs up your advertising campaign and keeps your name in the alphabetical index.

Uncovering Profit-opportunities for 1928

The New York Power Show will uncover many new opportunities for profit through more efficient operation.

Here's the motor for that job!

One of your best opportunities to reduce production costs and widen your profit-margin in 1928 will be your application of the TR Super-Motor.

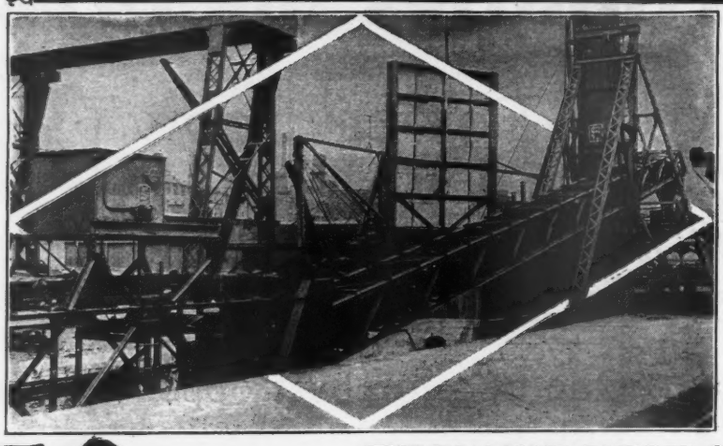
Have us prepare a Triumph Survey on the motoring efficiency of your plant. Our recommendations are saving costs in plant after plant. Our engineers in all principal cities are at your service.

Smaller motors, no compensator troubles, simple push-button remote control, lower current bills and higher power factor by using TR Super-Motors! The TR is an A.C. motor with improved operating characteristics. 250% starting pull instead of usual 80%! No compensator in any size. Cuts first cost and current cost. We also build standard squirrel cage and slip-ring motors. Triumph recommendations provide the most efficient motoring for your entire A.C. load.

TRIUMPH
ELECTRIC CORPORATION

152 East 70th Street Cincinnati, O. Offices in Principal Cities

50% of the handling cost SAVED
. . . and 50% of coaling-time!



THIS coal-handling installation — made by the Webster Manufacturing Co., of Chicago, and equipped with Diamond Rubber Belts—consists of two belt conveyors 40" wide; one horizontal and one inclined.

The horizontal conveyor carries the coal from the storage bin to the inclined conveyor, which discharges directly into the bunkers of the vessel alongside the wharf.

Both conveyors are movably mounted in a steel frame which operates on a track; the inclined conveyor can be raised or lowered according to the freeboard of the vessel being coaled. Coal is automatically sprinkled and weighed. There is no breakage.

The installation attracts all the customers it can serve, because vessels will not wait for slower, old-fashioned coaling. Investigate the possibilities of Diamond Conveyor Belts for *your* business.

THE DIAMOND RUBBER COMPANY, Inc., Akron, Ohio

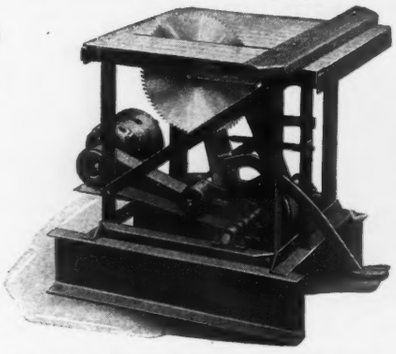
Atlanta Boston Kansas City New York Philadelphia
Chicago Dallas Los Angeles Seattle San Francisco

Diamond

Rubber Belting ~ Hose · Packing

Cut your crating costs with the Parks "Clipper"

$165.00 with 2 H. P. motor



Swing cut-off and rip saw built for heavy duty. Big work—little price! Guaranteed 10 years. Your present crating cost will show you need this saw. It will do more work than an extra man and pay its small first cost in a few weeks.

Send the coupon for complete specifications today!

FILL OUT AND MAIL THIS COUPON—NOW!

I.E.

The Parks Wood-Working Machine Co.
1600 Knowlton Street.
Cincinnati, Ohio

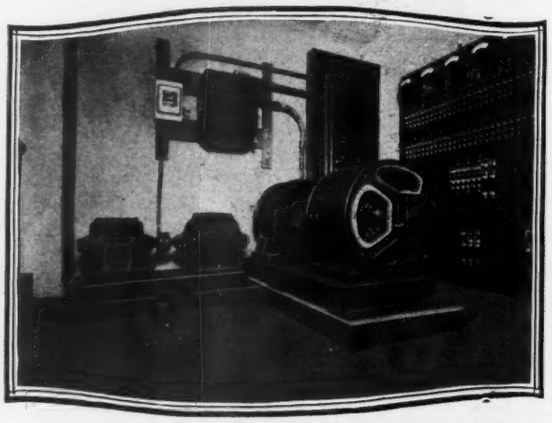
Send specification sheet on Parks "Clipper" factory saw.

Name .....

Address .....

City ..... State.....

PARKS
WOODWORKING MACHINES



DIEHL MOTOR GENERATOR SETS

Diehl motor generator sets are used for many purposes ranging from supplying direct current for laboratory uses in schools to operating heavy magnet cranes. In Diehl motor generator sets are incorporated many exclusive features combined with rugged construction, high electrical efficiency and ample ventilating and lubricating facilities. Diehl engineers can help you with your motor problems.

Write for descriptive bulletins—now

DIEHL MANUFACTURING CO.
ELIZABETHPORT, N. J.

Atlanta Boston Chicago Detroit New York Philadelphia

DIEHL

BUILDERS OF FANS AND MOTORS SINCE 1888

There's a New STAR in the ascendency!

A new Starter-less GENERAL PURPOSE squirrel cage motor with 10 specific betterments—

★ Self-starting across-the-line, doing away with the need for compensators or other current-limiting devices.

★ Similar in every way to the standard single squirrel cage general purpose motor, with all of this type's desirable features.

★ Costs no more than the ordinary motor; effects a substantial saving in first cost with elimination of extra starting devices.

★ Low cost maintenance and greater reliability in the absence of intricate control equipment.

★ Full power available at starting, making the frequent practice of over-motoring unnecessary.

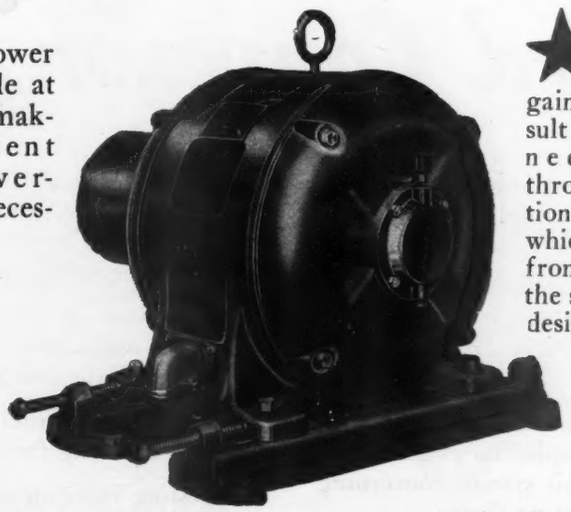
★ Starting current inrush within N.E.L.A. requirements without impairment of efficiency and power factor.

★ Heavy one-piece cast grey iron frames, assuring perfect alignment of all motor parts when installed.

★ Made in sizes up to 30 h.p. and with synchronous speeds of 900, 1200 and 1800 r.p.m., for general industrial applications.

★ Equipped, like all Star Motors, with large ball bearings, mounted in such a way as to produce a compact, rigid and reliable machine.

★ All of which advantages have been gained solely as the result of advanced engineering and not through the introduction of innovations which might detract from the reliability of the single squirrel cage design.



Write for full details of this exceptional power unit. And remember, Star was the first motor manufacturer to give evidence of progressive thinking by adopting ball bearings exclusively.

STAR ELECTRIC MOTOR COMPANY

Manufacturers of A. C. and from ¼ h.p.

D. C. Ball Bearing Motors to 100 h.p.

140 Miller Street, Newark, N. J.

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New York, N. Y., 30 Church St.
Pittsburgh, Pa., 712 Ferguson Bldg.
Rochester, N. Y., 165 Clinton Ave. N.
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Milwaukee, Wisc., 1092 National Ave.
Chicago, Ill., 9 So. Clinton St.
Cleveland, O., Rockefeller Bldg.
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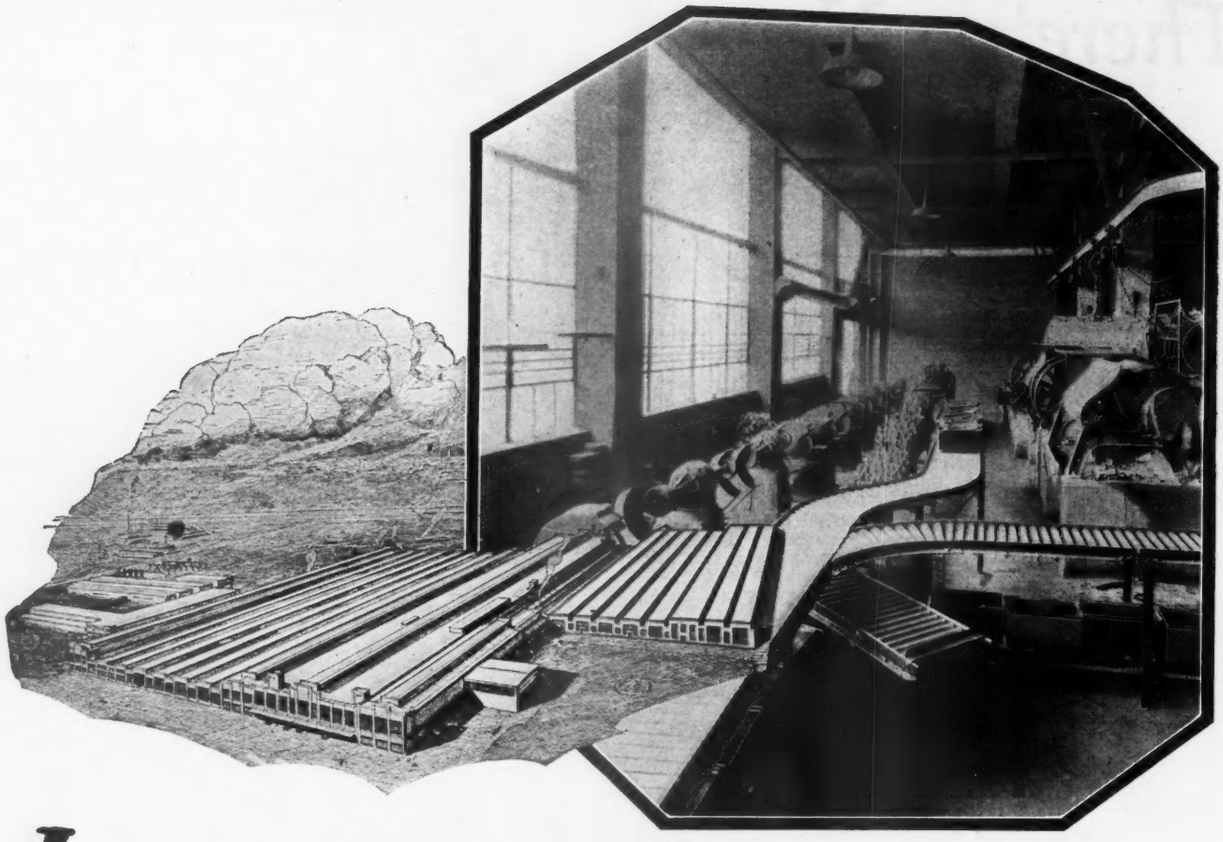
Boston, Mass., 176 Federal St.
Cincinnati, O., 315 Elm St.
High Point, N. C., 309 E. Russell St.



Low cost mileage — a Standard Conveyor feature

Day and night in automotive production, tons of metal are transported over miles and miles of Standard Conveying Systems.

The maintenance men in automotive plants have a comparatively simple job in operating these conveyors. The reports they turn in show great ease of maintenance.

Standard Conveying Systems require only systematic greasing. For example the Nash maintenance man has perfected his system concerning which there are some interesting facts.

The bearings in the rollers have an exceptionally long life even though they sustain the entire working load of the conveyor and are in constant motion. The Chrysler engineer has some interesting facts regarding this.

Replacements of both bearings and rollers are simple to make, taking little time and effort and causing no serious delays on the assembly line.

Our handling counselors can propose good maintenance checking factors for you.

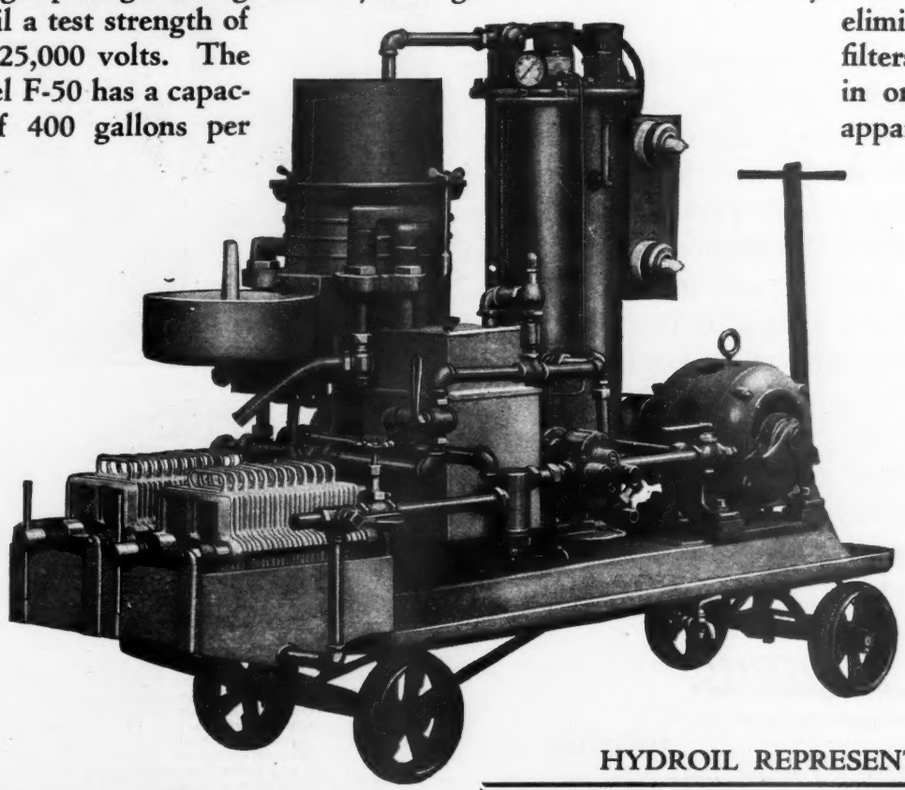
Interesting facts on maintenance savings through Standard Conveyor Systems in the Automotive field can be mailed to you.

STANDARD
CONVEYOR COMPANY
NORTH ST. PAUL, MINNESOTA

For Plant Efficiency— Purify Switch Breaker and Transformer Oil the HYDROIL Way

Industrial plants with numerous oil switches and circuit breakers or large batteries of transformers will be interested in the Model F-50 Hydroil. Complete restoration of the dielectric strength in oil is attained in the shortest possible time. A single passage through the Hydroil gives the oil a test strength of over 25,000 volts. The Model F-50 has a capacity of 400 gallons per hour, making it invaluable for emergency work such as cleaning the contents of large transformers with the minimum of service interruptions.

A complete oil purifying service is obtained with the F-50 Hydroil Heaters, bowl, air-eliminating device and filters are all connected in one line. No extra apparatus is required.



Hydroil
SALES CORPORATION
LEBANON, INDIANA

HYDROIL REPRESENTATIVES:

Power Equipment Company,
250 Stuart Street, Boston, Mass.
Lee Skipwith & Co.,
369 Lexington Ave., New York, N. Y.
The Bradley Company,
2401 Chestnut St., Philadelphia, Pa.
E. S. Stickle Company,
40 West Seneca St., Buffalo, N. Y.
E. S. Stickle Company
934 Union Trust Bldg., Pittsburgh, Pa.
Farnham & Cunningham.
307 South Hill Street, Los Angeles, Calif.
H. M. Thomas Company,
589 Howard St., San Francisco, Cal.
H. M. Thomas Company,
(Mr. R. H. Ballock)
71 Columbia St., Seattle, Wash.
Independent Electric Company,
603 Baker Bldg., Minneapolis, Minn.
Powerlite Devices, Ltd.,
124 Richmond Street, West,
Toronto, Ontario, Canada.
E. S. Stickle Company,
342 Rockefeller Bldg., Cleveland, O.

MANHATTAN RUBBER—another user

These four photographs show views of the Logan system in the Manhattan plant. Conveyors bring empty tote boxes to be filled with crude rubber, then forward them to refining operations. Each box is automatically weighed en route without removal from conveyor. Besides functioning as carriers between operations, long lines of Gravity Rollers serve as storage for rubber in process of tempering. In this comprehensive installation Logan Gravity Conveyors, Belt Conveyors and Vertical Elevators are used.

THEY *knew what they wanted!* The Manhattan Rubber Mfg. Co. is one of the world's leading makers of fine conveyor belts. Years of experience have naturally given them a wide knowledge of conveyors as well. They already appreciated the economical principle of mechanical handling and for the double assurance of dependable, care-free operation in their own plant they chose Logan Conveyors . . . . For the same reason—the certainty of correct design and that element of plus service—leaders in every line of industry are using Logan Conveyors. Send for list of well-known users and your copy of "*Seven Economies of Logan Conveyors*". No obligations.

Logan Co.

(Formerly THE DOW CO.)

512 N. Buchanan St. LOUISVILLE, KY.

Offices in Principal Cities

THE MANHATTAN RUBBER MFG. CO. PASSAIC, N.J.

Slipless, stretchless and, best of all, practically wearless — Manhattan Conveyor Belts are outstandingly successful because they're made individually for particular jobs. Logan Conveyors are built on the same principle. Whatever you make or handle, there is a specialized Logan design that will fully meet your needs. Ask for an appointment with a Logan engineer.

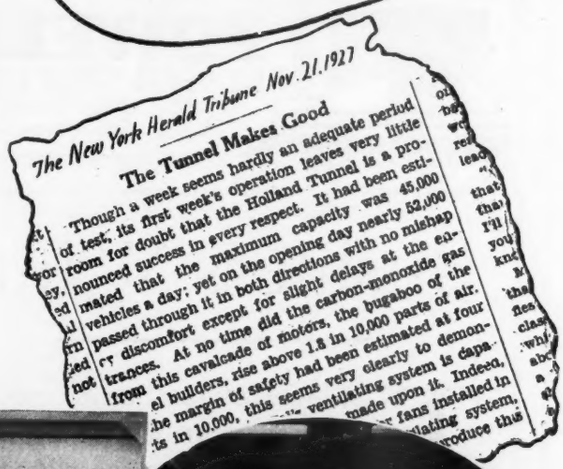
Logan Conveyors

LOUISVILLE

Have you ever had a job like this

To engineer and design control for the ventilation of a project such as the new Holland Tunnels.

SUNDH did it!


The New York Herald Tribune Nov. 21, 1927

The Tunnel Makes Good

Though a week seems hardly an adequate period of test, its first week's operation leaves very little room for doubt that the Holland Tunnel is a pronounced success in every respect. It had been estimated that the maximum capacity was 45,000 vehicles a day; yet on the opening day nearly 52,000 passed through it in both directions with no mishap or discomfort except for slight delays at the entrances. At no time did the carbon-monoxide gas from this cavalcade of motors, the bugaboo of the tunnel builders, rise above 1.8 in 10,000 parts of air. The margin of safety had been estimated at four in 10,000, this seems very clearly to demonstrate the ventilating system is capable made upon it. Indeed, fans installed in ventilating system, produce this

This is only one of many large undertakings where Sundh engineering and apparatus has "made good."

The Business of Sundh is divided into Four Steps:

1. To find out conditions that actually exist.
2. To decide upon the equipment best suited to the job.
3. To build and assemble that equipment.
4. To deliver the equipment on time.

If you have not received a copy of the New Sundh Catalog you should do so by all means—write for your copy today.

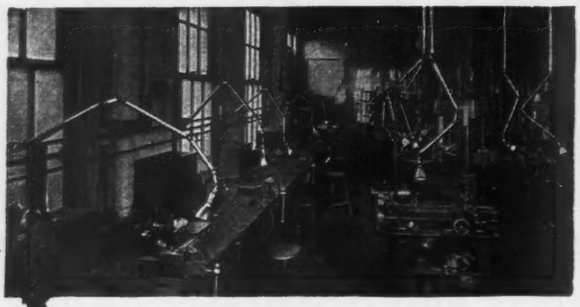
SUNDH ELECTRIC COMPANY

No. 5 Ave. C, Newark, N. J.

Branch Offices: Chicago, New York

Sales Representatives:

Birmingham	Buffalo	Detroit	Los Angeles	Omaha	Portland, Ore.	St. Louis
Baltimore	Cleveland	Denver	Minneapolis	Philadelphia	San Francisco	Montreal, Can.
Boston	Cincinnati	Kansas City	New Orleans	Pittsburgh	Seattle	Toronto, Can.



LIGHT UP and Production will Pick Up

American Adjustable Fixtures are now furnished with conduit fittings, permitting a neater, safer, more substantial job. Catalog gives full details. Copy free.

Do your men have to look twice at every measurement and adjustment because they can't trust their eyes? Install American Adjustable Fixtures at your machines and benches and production will be greatly increased as well as the quality of the work.

AMERICAN FIXTURE COMPANY
232 West Water St. MILWAUKEE
Write for Catalog and Prices

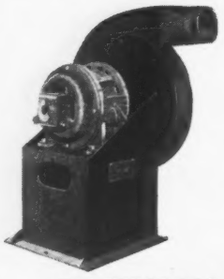
POWELL
PRESSED STEEL
MATERIAL HANDLING EQUIPMENT

You Save Their Cost Over and Over!

CONTINUOUS use in connection with any handling operation, soon reveals the basic economy of POWELL pressed steel Material Handling Equipment. Varied to meet any handling need—always giving maximum strength and service. Ask us for full details and prices now!

The POWELL PRESSED STEEL CO.
HUBBARD, OHIO
Suburb of Youngstown

ROBINSON
Fans and Blowers



Adequate Air Man-Cooling Fans Brick Fans — Mine Fans Pressure Blowers Special Fans for Special Work.

Details on request

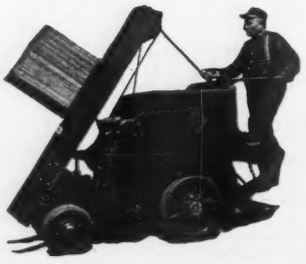
ROBINSON VENTILATING CO.
ZELIENOPLE, PA.

Elwell-Parker Tin-Plate
ELECTRIC LIFT TRUCTOR

Picks Up
Tilts
Transports and
Stacks

All accomplished electrically

Request details as to this new special, illustrated in Bulletin A535.



The Elwell-Parker Electric Co., Cleveland

Business Wants

THE *Searchlight* Section of this paper represents a meeting place for men and concerns who have immediate business "wants" to fill—the section covers

Agencies Wanted
Agents Wanted
Books and Periodicals
Business Opportunities
Civil Service Opportunities
Contracts Wanted
Desk Room for Rent or Wanted
Educational
Employment Agencies
Employment Service
Foreign Business
For Exchange
For Rent
For Sale
Franchises
Labor Bureaus
Miscellaneous Wants
New Industries Wanted
Office Space for Rent or Wanted
Partners Wanted
Patent Attorneys
Patents for Sale
Plants for Sale
Positions Vacant
Positions Wanted
Property for Sale
Representatives Wanted
Salesmen Available
Salesmen Wanted
Spare Time Work Wanted
Sub-Contracts Wanted
Tutoring
Vacation Work Wanted
Work Wanted

"SEARCHLIGHT"

Simple as Flange Couplings— But Flexible

Without movement or wear on the shaft flanges, Francke couplings protect the connected shafts, bearings and machines against excessive strains caused by shafts running out of line. They also provide a spring cushion for load shocks and vibrations.

FRANCKE
FLEXIBLE COUPLINGS

"They make good machines last longer."

Used on

Electric Motors
Steam Engines
Gas Engines
Diesel Engines
Steam Turbines
Water Turbines

Direct-Connected
And on
Reduction Gears
And Chain Drives
To

Agitators
Ball Mills
Blowers
Calenders
Compressors
Conveyors
Cranes
Crushers
Elevators
Exhausters
Fans
Generators
Grinders
Hogs
Hoists
Line Shafts
Machine Tools
Mill Drives
Mixers
Pulverizers
Pumps
Saws
Screens
Screw Downs
Shears
Tube Mills
Etc.

Installed like a simple flange coupling, Francke flexible couplings provide an ever ready means for checking shaft alignment by using a steel straight edge across the flanges.

Endwise movement and flexibility in all directions are obtained by flexible laminated steel pin units which are locked in one flange and which are free to move in bronze bushings within the other flange.

Sizes up to 500-750 H.P. (usual motor ratings) in stock and larger sizes up to 5000 H.P.—all are made with interchangeable parts.

Ask for descriptive bulletin and handy Selector charts.

SMITH & SERRELL
Coupling Specialists Since 1912
26 Washington Place, Newark, N. J.

WHAT AND WHERE TO BUY

Equipment, Apparatus and Supplies Advertised in this Issue with Names of Manufacturers and Distributors

Prospective purchasers in the electrical-mechanical market are invited to apprise us of their needs, assuming, of course, that the articles sought are not listed here.

Agitator Tanks
Paints, Rubber, Cement, etc.
Bowser & Co., S. F.
Agitators
New England Tank & Tower Co.
Air Compressors
Allis-Chalmers Mfg. Co.
Air Conveying Equipment
American Blower Co.
Buffalo Forge Co.
Air Filters
Midwest Steel & Supply Co.
Air Gap Gauges
Grinder Sales Co.
Air Washers, Coolers, Humidifiers
American Blower Co.
Buffalo Forge Co.
Ammeters, Voltmeters (See Instruments, Electrical).
Armature & Field Testers
Martindale Electric Co.
Armature Coil Spreaders
Armature Coil Equipment Co.
Armature Coil Winders
Armature Coil Equipment Co.
Armature Repair Machinery
Armature Coil Equipment Co.
Armature Washing Fluid
Martindale Electric Co.
Armature Winders' Tools
Grinder Sales Co.
Armored Conductor
Tubular Woven Fabric Co.
Asbestos
Johns-Manville Co.
Babbitt
Magnolia Metal Co.
Barrels, Steel Shop
The Kirk & Blum Mfg. Co.
Batteries
Dry
National Carbon Co.
Battery Charging Apparatus
General Electric Co.
Westinghouse Electric & Mfg. Co.
Beads, Insulating
Martindale Electric Co.
Bearings
Chicago Pulley & Shafting Co.
Dodge Mfg. Corp.
Eureka Copper Prod. Corp.
Royersford Fdry. & Mach Co.
Trester Service Electric Co.
Webster Mfg. Co.
Wood's Sons Co., T. B.
Aligning
Fafnir Bearing Co.
Angular Contact
Fafnir Bearing Co.
Anti-Friction
Fafnir Bearing Co.
Armature
Fafnir Bearing Co.
Ball
Ahlberg Bearing Co.
Fafnir Bearing Co.
Hyatt Roller Bearing Co.
New Departure Mfg. Co..
Norma Hoffmann Co.
Wood's Sons Co., T. B.
Motor
Norma Hoffmann Co.
Precision
Norma Hoffmann Co.
Roller
Ahlberg Bearing Co.
Hyatt Roller Bearing Co.
Norma Hoffmann Co.
Royersford Fdry. & Mach Co.
Timken Roller Bearing Co..
Tapered
Timken Roller Bearing Co.
Thrust
Fafnir Bearing Co.
Norma Hoffmann Co.
Timken Roller Bearing Co.
Bearing Metal
Dodge Mfg. Corp.
General Electric Co.
Magnolia Metal Co.
Westinghouse Electric & Mfg. Co.
Belt, Cement
Schieren Co., Chas. A.
Belt Contactors
Wood's Sons Co., T. B.
Belt Dressing
Cling Surface Co.
Schieren Co., Chas. A.
Standard Oil Co., Ind.
Belt Drivers
Smidth & Co., F. L.
Belting
Alexander Bros., Inc.
Chicago Pulley & Shafting Co.
Houghton & Co., E. F.
I. B. Williams & Sons
Leather
Schieren Co., Chas. A.
Leather Link
Schieren Co., Chas. A.
Waterproof Leather
Schieren Co., Chas. A.
Belts, Conveyor
Diamond Rubber Co.
Link-Belt Co.
Webster Mfg. Co.
Belts, Elevator
Diamond Rubber Co.
Belts, Transmission
Diamond Rubber Co.
Link-Belt Co.
Bleachers
Worcester Bleach & Dye Works Co.
Blocks, Pillow
Chicago Pulley & Shafting Co.
Fafnir Bearing Co.
Jones Fdry. & Mach. Co..
Medart Co.
Webster Mfg. Co.
Blow Torches
McGill Mfg. Co.
Blowers
American Blower Co.
Buffalo Forge Co.
Breuer Elec. Mfg. Co.
Clements Mfg. Co.
De Laval Steam Turbine Co.
Kirk & Blum Mfg. Co.
Martindale Electric Co.
Sturtevant Co., B. F.
Centrifugal
De Laval Steam Turbine Co.
Electric
Breuer Elec. Mfg. Co.
Electric Portable
Breuer Elec. Mfg. Co.
Clements Mfg. Co.
Blow-Pipe Systems
The Kirk & Blum Mfg. Co.
Bobs
Philadelphia Gear Works
Bolts, Nuts and Screws
Sturtevant Co., B. F.
Bonds, Rail
Ohio Brass Co.
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McGraw-Hill Book Co.
Boosters
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Electric & Mfg. Co.
Boxes
Conduit
Appleton Electric Co.
Colt's Patent Fire Arms Mfg. Co.
McGill Mfg. Co.
Floor Outlet
Adam Electric Co., Frank
Harvey Hubbell, Inc.
Hanger
Fafnir Bearing Co.
Junction and Outlet
Appleton Electric Co.
General Electric Co.
Harvey Hubbell, Inc.
Trumbull Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.
Meter and Service
Colt's Patent Fire Arms Mfg. Co.
General Electric Co.
Trumbull Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.
Sectional Switch and Outlet
Appleton Electric Co.
Sheet Metal Tote
The Kirk & Blum Mfg. Co.
Brackets, Instrument
Trumbull Elec. Mfg. Co.
Brake Drums, Hardened
Tool Steel Gear & Pinion Co.
Brakes
Electric Controller & Mfg. Co.
Westinghouse Electric & Mfg. Co.
Disc
Westinghouse Electric & Mfg. Co.
Electric
Cutler-Hammer Mfg. Co.
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Westinghouse Electric & Mfg. Co.
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Osborn Mfg. Co.
Brushes
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Carbon
Baylis Co., The
Boxill-Bruel Carbon Co.
Commutator
Carbon Engrg. Co.
Eureka Copper Products Corp.
General Electric Co.
Morganite Brush Co., Inc.
National Carbon Co.
Ohio Carbon Co.
Westinghouse Electric & Mfg. Co.
Dynamic and Carbon
Morganite Brush Co., Inc.
National Carbon Co.
Ohio Carbon Co.
Westinghouse Electric & Mfg. Co.
Gauze Wire Dynamo
Martindale Electric Co.
Generator
Ohio Carbon Co.
Slip Ring
Ohio Carbon Co.
Brush Holders
Baylis Co., The
Electric Accessories Co.
Eureka Copper Products Corp.
Westinghouse Electric & Mfg. Co.
Bus Bar Supports
General Electric Co.
Railway & Ind. Engrg. Co.
Westinghouse Electric & Mfg. Co.
Bushings
Appleton Electric Co.
Eureka Copper Products Corp.
Porcelain
Ohio Brass Co.
Cables (See Wire & Cable)
Cable Accessories
Dossert & Co.
General Electric Co.
Westinghouse Electric & Mfg. Co.
Cableways
Williamsport Wire Rope Co.
Car Movers
Powell & Son, G. D.
Carbon Brushes
(See Brushes)
Carbons
Contact
Ohio Carbon Co.
Elevator
Ohio Carbon Co.
Welding
Ohio Carbon Co.
Casters
Bassick Co.
Castings, Die
Magnolia Metal Co.
Castings, Steel
Falk Corp.
Cement, High Pressure
Johns-Manville Co.
Centrifugal Separators
Hydroil Sales Corp.
Centrifugals
De Laval Separator Co.
Chains
Outo Engine
Ramsey Chain Co.
Autombile Timing
Ramsey Chain Co.
Auto Transmissions
Ramsey Chain Co.
Automotive Replacement
Ramsey Chain Co.
Block
Whitney Mfg. Co.
Compensating Joint
Ramsey Chain Co.
Drive
Ramsey Chain Co.
Flat Tink
Ramsey Chain Co.
Roller
Whitney Mfg. Co.
High Speed, Silent Running
Ramsey Chain Co.
Silent
Whitney Mfg. Co.
Silent Transmission
Ramsey Chain Co.
Sprocket Wheel (Silent Drive)
Ramsey Chain Co.
Steel
Ramsey Chain Co.
Transmission
Ramsey Chain Co.
Chains, Power Transmission
Diamond Chain & Mfg. Co.
Link-Belt Co.
Morse Chain Co.
Philadelphia Gear Works
Ramsey Chain Co.
Webster Mfg. Co.
Whitney Mfg. Co.
Circuit Breakers
Condit Electrical Mfg. Co.
Cutler-Hammer Mfg. Co.
Cutter Co.
General Electric Co.
Roller-Smith Co.
Sundh Electric Co.
Westinghouse Electric & Mfg. Co.
Clamps
General Electric Co.
Railway & Ind. Engrg. Co.
Westinghouse Electric & Mfg. Co.
Cleaners, Metal Waste, General
Oakite Products, Inc.
Cleats
Square D. Co.
Clutches,
Dodge Mfg. Corp.
Chicago Pulley & Shafting Co.
Reeves Pulley Co.
Webster Mfg. Co.
Friction
Allis-Chalmers Mfg. Co.
Jones Fdry. & Mach. Co., W. A.
Link-Belt Co.
Wood's sons Co.,
Magnetic
Cutler-Hammer Mfg. Co.
Coal and Ash Handling Equipment
Dodge Mfg. Corp.
Link-Belt Co.
Webster Mfg. Co.
Coil Winding Machines
Armature Coil Equipment Co.
Coil Winding Tools
Grinder Sales Co.
Coils
Choke
American Transformer Co.
General Electric Co.
Railway & Ind. Engrg. Co.
Westinghouse Electric & Mfg. Co.
Coils, Induction
American Transformer Co.
Combinations, Switch, Choke Coil or Fuse
Railway & Ind. Engrg. Co.
Commutator Cement
Green Equipment Co.
Commutator Cleaner
Martindale Electric Co.
Commutator Equipment
Ideal Commutator Dresser Co.
Commutator Grinding Tools
Ideal Commutator Dresser Co.
Martindale Electric Co.
Commutator Slot Varnish
Martindale Electric Co.
Commutator Slotting Files
Martindale Electric Co.
Commutator, Slotting Machines
Martindale Electric Co.
Commutator Slotting Saws
Martindale Electric Co.
Commutator Stones
Green Equipment Co.
Grinder Sales Co.
Ideal Commutator Dresser Co.
Martindale Electric Co.
Commutators
Cleveland Armature Works
Commutators and Parts
Eureka Copper Products Corp.
Compensaters
Automatic
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Westinghouse Electric & Mfg. Co.
Manual
Allis-Chalmers Mfg. Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Industrial Controller Co.
Westinghouse Electric & Mfg. Co.
Compressors, Centrifugal
De Laval Steam Turbine Co.
Concrete Floor
Sonneborn Sons, Inc., L.
Concrete Inserts
Midwest Steel & Supply Co.
Conductors, Armored
Tubular Woven Fabric Co.
Conduit Fittings
Appleton Electric Co.
Conduits
Tubular Woven Fabric Co.
Wiremold Co.
Interior, Fibre and Underground
Johns-Manville Co.
Connectors and Terminals
Dossert & Co.
General Electric Co.
Ohio Elect. & Cont. Co.
Westinghouse Electric & Mfg. Co.
Contact Rail Insulators
Ohio Brass Co.
Control Systems
Kimble Electric Co.
Controller Parts
Eureka Copper Products Corp.
Controllers
Armored for Electric Circuits
Ohio Elec. & Controller Co.
Automatic
Allen-Bradley Co.
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Kimble Electric Co.
Lewellen Mfg. Co.
Rowan Controller Co.
Russell Mfg. Co.
Sundh Electric Co.
Westinghouse Electric & Mfg. Co.
Crane
Allen-Bradley Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
Sundh Electric Co.
Electric
Industrial Controller Co.
Ohio Elect. & Cont. Co.
Finger
Russell Mfg. Co.
Machine Tool
Sundh Electric Co.
Manual
Industrial Controller Co.
Sundh Electric Co.
Motor
Allen-Bradley Co.
Allis-Chalmers Mfg. Co.
Condit Electric Mfg. Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Kimble Electric Co.
Lewellen Mfg. Co.
Rowan Controller Co.
Russell Mfg. Co.
Square D. Co.
Sundh Electric Co.
Union Electric Co.
Westinghouse Electric & Mfg. Co.
Reversible
Russell Mfg. Co.
Speed
Kimble Electric Co.
Temperature and Pressure
Taylor Instrument Co.
Conveyors
Link-Belt Co.
Logan Co.
Palmer-Bee Co.
Richards-Wilcox Mfg. Co.
Webster Mfg. Co.
Wood's Sons Co., T. B.
Gravity
Standard Conveyor Co.
Coolers, Air
American Blower Co.
Buffalo Forge Co.
Copper Slotting Cutters
Hullhorst-Micro Tool Co.
Cord, Flexible
Harvey Hubbell, Inc.
Okonite Co., The
Rome Wire Co.
Simplex Wire & Cable Co.
Tubular Woven Fabric Co.

For the addresses of the manufacturers listed here, please refer to their advertisements in this issue. The index to advertisers may be found on page 142.

SEARCHLIGHT SECTION

EMPLOYMENT-BUSINESS OPPORTUNITIES-EQUIPMENT

UNDISPLAYED—RATE PER WORD:

Positions Wanted, 4 cents a word, minimum 75 cents an insertion, payable in advance.

Positions Vacant and all other classifications, 8 cents a word, minimum charge $3.00.

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I. E.

EMPLOYMENT SERVICE

IF you are qualified for position between $2,500 and $25,000, and are receptive to negotiations for new connections, your response to this announcement is invited. The undersigned provides a thoroughly organized service, established seventeen years ago, to conduct confidential preliminaries, and assist the qualified man in locating the particular position he desires. Not an employment agency. Retaining fee protected by refund provision, as stipulated in our agreement. Send name and address only for description of service. R. W. Bixby, Inc., 258 Main Street, Buffalo, New York.

EMPLOYMENT AGENCY

POSITION open for industrial and maintenance engineers, works managers, superintendent, production managers and time study men, draftsmen and designers. No registration fee. Free service to employers. Write Consolidated Agencies, formerly H. H. Harrison and Co., 110 South Dearborn St., Chicago.

POSITIONS WANTED

ELECTRICAL engineer; eighteen years' experience, capable of laying out, installing and maintaining plants, have handled men for past fifteen years. Married. Would like to take charge of electrical construction and maintenance in an industrial plant. Location immaterial. Employed but available within a month. PW-262, Industrial Engineering, 1600 Arch St., Phila., Pa.

POSITIONS WANTED

AT present employed but desire to make change; age 33; experience 15 years electrical maintenance and construction work, 4 years of this time on electric welding equipment; capable of handling men and running job; ten years with present employer. PW-263, Industrial Engineering, Guardian Bldg., Cleveland, Ohio.

CHIEF electrician, 38, married, with fifteen years' experience on maintenance and installation, desires permanent position; technical education. PW-264, Industrial Engineering, Tenth Ave. at 36th St., New York.

ELECTRICIAN, 14 years' experience A.C.-D.C., capable of taking charge, desires position in East. Married, age 31. PW-265, Industrial Engineering, Tenth Ave. at 36th St., New York.

PLAN NOW FOR THE FUTURE—
Train to be a **Meter Engineer!**

Competent meter engineers earn from $3,000 to $5,000 a year! The demand for thoroughly trained men is constant. Get into this profitable and fascinating profession now. Our home study course will train you quickly and start you on the road to a larger salary as a meter expert. It has been prepared by authorities and has the recognition of the largest Public Utility Companies as the most practical course. FREE BOOKLET—get the facts now! Write for our interesting descriptive booklet. Sent free without obligation to you.

Fort Wayne Correspondence School
Dept. 82, Ft. Wayne, Indiana

FREE BULLETINS

GREGORY ELECTRIC CO., 16th and Lincoln Sts., Chicago, Ill.—The November issue of this company's monthly bargain sheet of hi-grade rebuilt motors and electrical machinery has just been issued. A special announcement accompanying this booklet states that "this issue contains the most complete and drastic downward revision of prices in our history."

HYMAN-MICHAELS CO., Peoples Gas Bldg., Chicago, Ill.—Bulletin 140, just issued, is a 16-page list of used machinery and equipment suitable for mines, mills, plants and contractors, offered from the company's plants in St. Louis, East Chicago, San Francisco, Seattle and Portland.

BARGAINS IN

FREQUENCY CHANGERS
for high speed woodworking machinery.

PLATING GENERATOR SETS
50 to 6000 amperes.

SLOW SPEED MOTORS

The Motor Repair & Mfg. Co.
Cleveland, Ohio

OVER 12,000 other men in responsible charge of Operation & Maintenance work in Industrial Plants of every variety throughout the country, will see these pages—

Then isn't this the logical place to advertise any business wants you may have of interest to operation and maintenance men?

EMPLOYMENT — BUSINESS — EQUIPMENT OPPORTUNITIES, ETC., ETC., ETC.

Cotton Yarns
Worcester Bleach & Dye Works Co.

Counters
Veeder Mfg. Co.

Coupling Boxes
Tool Steel Gear & Pinion Co.

Couplings,
Wood's Sons Co., T. B.
Flexible
Allis-Chalmers Mfg. Co.
Chicago Pulley & Shafting Co.
De Laval Steam Turbine Co.
Dodge Mfg. Corp.
Falk Corp.
Foote Bros. Gear & Mach. Co.
Jones Fdry. & Mach. Co.
Nuttall Co., R. D.
Palmer-Bee Co.
Philadelphia Gear Works
Smith & Serrell
Shaft
Wood's Sons Co., T. B.

Crankcase, Oil Reclaimer
De Laval Separator Co.

Crane Controllers
Allen-Bradley Co.

Crane Motors
Kimble Electric Co.
Sundh Electric Co.
Westinghouse Electric & Mfg. Co.

Crane Gears, Hardened
Tool Steel Gear & Pinion Co.

Crane Wheels, Hardened
Tool Steel Gear & Pinion Co.

Cranes, Electric
Triumph Electric Co.

Cranes, Portable Electric
Elwell-Parker Co.
Shepard Elec. Crane & Hoist Co.

Crating Saws
Parks Woodworking Machine Co.

Cutouts
Arrow Electric Co.
Colt's Patent Fire Arms Mfg. Co.
General Electric Co.
Harvey Hubbell, Inc.
Square D. Co.
Trumbull Elec. & Mfg. Co.
Westinghouse Electric & Mfg. Co.

Cutters
Commutator Slotting
Hullhorst Micro Tool Co.
Key-Seat
Whitney Mfg. Co.

Cutting Compound
Oakite Products, Inc.

Diagrams
McGraw-Hill Book Co.

Doors, Sliding
Richards-Wilcox Mfg. Co.

Doorways
Richards-Wilcox Mfg. Co.

Drills
Buffalo Forge Co.

Drives
Smidth & Co., F. L.
Rope
Wood's Sons Co., T. B.
Short Center
Wood's Sons Co., T. B.
Short Center—Leather Belt
Bird Machine Co.
(Pulmax Drive)
Silent Chain
Grant Gear Works, Inc.
Link-Belt Co.
Whitney Mfg. Co.

Drying Apparatus
Buffalo Forge Co.

Dust Collecting Systems
Kirk & Blum Mfg. Co.

Dynamos
(See Generators & Motors)

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Resistance Type
Ohio Brass Co.

Electric Etchers
Martindale Electric Co.

Electric Lighting
Westinghouse Electric & Mfg. Co.

Elevator Control & Switchboard Washers
Grinder Sales Co.
Dodge Mfg. Corp.

Elevators & Conveyors
Dodge Mfg. Corp.
Link-Belt Co.
Webster Mfg. Co.

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American Blower Co.
Allis-Chalmers Mfg. Co.
Steam
Buffalo Forge Co.

Extractors, Centrifugal
De Laval Separator Co.

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Osborn Mfg. Co.

Fan Hangers, Electric
Adam Electric Co., Frank

Fan Motors
Century Electric Co.
General Electric Co.
Kimble Electric Co.
Kirk & Blum Mfg. Co.
Westinghouse Electric & Mfg. Co.

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Buffalo Forge Co.
Diehl Mfg. Co.
National Screw & Mfg. Co.
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Robinson Ventilating Co.
Exhaust and Ventilating
Century Electric Co.
General Eectric Co.
Kimble Electric Co.
The Kirk & Blum Mfg. Co.
Sturtevant Co., B. F.
Westinghouse Electric & Mfg. Co.
Turbine
Robinson Ventilating Co.

Fibre Wedge Drivers
Grinder Sales Co.

Files, Commutator Slotting
Martindale Electric Co.

Filters
Continuous for Turbines
Bowser & Co., S. F.
Transformer Oil
Bowser & Co., S. F.

Fixtures, Lighting
American Fixture Co.
McGill Mfg. Co.
Miller Co.
Westinghouse Electric & Mfg. Co.

Flexible Shaft Machinery, Portable
Haskins & Co., R. G.

Friction Clutches
Foote Bros. Gear & Mach. Co.

Furnaces, Electric
General Electric Co.
Westinghouse Electric & Mfg. Co.

Fuse Clips
Trumbull Electric Mfg. Co.

Fuse Holders
Railway & Ind. Engrg. Co.

Fuse Plugs
Arrow Electric Co.
Harvey Hubbell, Inc.
Trico Fuse Mfg. Co.
Westinghouse Electric & Mfg. Co.

Fuse Puller Pliers
Grinder Sales Co.
Trico Fuse Mfg. Co.

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Colt's Patent Fire Arms Mfg. Co.
General Electric Co.
Trico Fuse Mfg. Co.
Renewable
Bussmann Mfg. Co.
Trico Fuse Mfg. Co.
Westinghouse Electric & Mfg. Co.
Non-Renewable
Trico Fuse Mfg. Co.

Gaskets
Sarco Co.

Gasoline Tanks & Pumps
Bowser & Co., S. F.

Gear & Wheel Pullers
Premier Electric Co.

Gear Cutting
Earle Gear & Machine Co.

Gears
Chicago Pulley & Shafting Co.
Cleveland Worm & Gear Co.
Dodge Mfg. Corp.
Earle Gear & Machine Co.
Falk Corp.
Foote Bros. Gear & Mach. Co.
General Electric Co.
Grant Gear Works, Inc.
Horsburgh & Scott Co., The
Jones Fdry. & Mach Co.,
Link-Belt Co.
Morse Chain Co.
Nuttall Co., R. D.
Palmer-Bee Co.
Philadelphia Gear Works
Smith, Winfield H.
Tool Steel Gear & Pinion Co.
Webster Mfg. Co.
Westinghouse Electric & Mfg. Co.
Whitney Mfg. Co.
Bevel
Foote Bros. Gear & Mach. Co.
Horsburgh & Scott Co.
Tool Steel Gear & Pinion Co.
Cast Iron, Steel, Bronze
Foote Bros. Gear & Mach. Co.
Composition
General Electric Co.
Westinghouse Electric & Mfg. Co.
Double Helical
De Laval Steam Turbine Co.
Foote Bros. Gear & Mach. Co.
Tool Steel Gear & Pinion Co.
Forged
Philadelphia Gear Works
Helical
De Laval Steam Turbine Co.
Falk Corp.
Foote Bros. Gear & Mach. Co.
Tool Steel Gear & Pinion Co.
General
Foote Bros. Gear & Mach. Co.
Herringbone
Falk Corp.
Foote Bros. Gear & Mach. Co.
Horsburgh & Scott Co., The
Micarta
Foote Bros. Gear & Mach. Co.
Rawhide
Foote Bros. Gear & Mach. Co.
Reducing
Cleveland Worm & Gear Co.
Foote Bros. Gear & Mach. Co.
Winfield H. Smith
Tool Steel Gear & Pinion Co.
Speed Reduction
Foote Bros. Gear & Mach. Co.
Spiral
Foote Bros. Gear & Mach. Co.
Horsburgh & Scott Co., The
Spur
Foote Bros. Gear & Mach. Co.
Tool Steel Gear & Pinion Co.
Worm
Cleveland Worm & Gear Co.
De Laval Steam Turbine Co.
Foote Bros. Gear & Mach. Co.
Horsburgh & Scott Co., The

Generating Sets
Allis-Chalmers Mfg. Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
General Electric Co.
Marble-Card Electric Co.
Triumph Electric Co.
Westinghouse Electric & Mfg. Co.

Generators
Allis-Chalmers Mfg. Co.
Burke Electric Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Electro Dynamic Co.
General Electric Co.
Lincoln Electric Co.
Marble-Card Elec. Co.
Reliance Electric & Eng. Co.
Triumph Electric Co.
Westinghouse Electric & Mfg. Co.

Governors, Belt Tension
Bird Machine Co.
(Pulmax Drive)

Grease Lubricators
Bowser & Co., S. F.

Grinders
Chicago Pulley & Shafting Co.
Martindale Electric Co.
Tool
Fafnir Bearing Co.

Grinding & Polishing
Strand & Co., N. A.

Grinding Appliances
Smidth & Co., F. L.

Grinding Compound
Oakite Products, Inc.

Ground—Ohmers
Herman H. Sticht & Co.

Grounding Devices
Dossert & Co.

Guards, Machinery
The Kirk & Blum Mfg. Co.

Hanger Boxes
Chicago Pulley & Shafting Co.
Fafnir Bearing Co.
Wood's Sons Co., T. B.

Hangers
Wood's Sons Co., T. B.

Hangers, Line Shaft
American Pulley Co.
Chicago Pulley & Shafting Co.
Dodge Mfg. Corp.
Fafnir Bearing Co.
Jones Fdry. & Mach. Co.,
Link-Belt Co.
Webster Mfg. Co.

Hangers, Safety Disconnecting
Thompson Electric Co.

Hangers, Shaft Ball Bearing
Chicago Pulley & Shafting Co.
Fafnir Bearing Co.
Wood's Sons Co., T. B.

Hardware, Pole Line
Ohio Brass Co.

Headlights, Arc & Incandescent
Ohio Brass Co.

Heating and Ventilating
American Blower Co.
Buffalo Forge Co.
The Kirk & Blum Mfg. Co.

Heating Devices, Industrial
General Electric Co.
Westinghouse Electric & Mfg. Co.
Wiegand Co., E. L.

Hoists, Electric
General Electric Co.
Link-Belt Co.
Shepard Elec. Crane & Hoist Co.

Hose
Air
Diamond Rubber Co.
Chemical
Diamond Rubber Co.
Fire
Diamond Rubber Co.

Humidifiers
American Blower Co.
Buffalo Forge Co.

Hydraulic Packings, Leather
Schieren Co., Chas. A.

Hydraulic Turbines
De Laval Steam Turbine Co.

Indicators, Speed
(See Tachometers).

Industrial Ovens
The Kirk & Blum Mfg. Co.

Instrument Transformers
American Transformer Co.
General Electric Co.
Westinghouse Electric & Mfg. Co.

Instruments, Electrical
Graphic
General Electric Co.
Jewell Electrical Instrument Co.
Westinghouse Electric & Mfg. Co.
Indicating
Biddle, James G.
General Electric Co.
Jewell Electrical Instrument Co.
Taylor Instrument Co.
Westinghouse Electric & Mfg. Co.
Weston Electrical Instrument Corp.
Integrating
General Electric Co.
Jewell Electrical Instrument Co.
Westinghouse Electric & Mfg. Co.
Scientific and Testing Service
Biddle, James G.
General Electric Co.
Jewell Electrical Instrument Co.
Westinghouse Electric & Mfg. Co.
Weston Electrical Instrument Co

Insulated Brackets
Fletcher Mfg. Co., The

Insulated Clamp Supports
Fletcher Mfg. Co., The

Insulated Clamps and Racks
Fletcher Mfg. Co., The

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Asbestos
Johns-Manville Co.
Comp. Cloth and Paper
General Electric Co.
Mica Insulator Co.
Westinghouse Electric & Mfg. Co.
Compounds, Paints and Varnishes
General Electric Co.
Irvington Varnish & Insulator Co.
Mica Insulator Co.
Okonite Co.
Westinghouse Electric & Mfg. Co.
Fibre, Tape and Webbing
Irvington Varnish & Insulator Co.
Mica Insulator Co.
Moulded
Johns-Manville Co.
Mica Insulator Co.

Insulators
General Electric Co.
Irvington Varnish & Insulator Co.
Ohio Brass Co.
Square D. Co.
Westinghouse Electric & Mfg. Co.
Cleat Type
Railway & Ind. Engrg. Co.
Contact Rail
Ohio Brass Co.
Fibre
General Electric Co.
Pin
Ohio Brass Co.
Porcelain
Ohio Brass Co.
Strain
Ohio Brass Co.
Suspension
Ohio Brass Co.
Tape and Webbing
General Electric Co.
Mica Insulator Co.
Okonite Co., The
Westinghouse Electric & Mfg. Co.

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Dossert & Co.

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Lamp Locks
Ren Mfg. Co.

Lamps
General Electric Co.
McGill Mfg. Co.
Trester Service Electric Co.
Westinghouse Electric & Mfg. Co.

Leather Specialties
Schieren Co., Chas. A.

Leveller Rolls
Tool Steel Gear & Pinion Co.

Lifting Magnets
Electric Controller & Mfg. Co.
Ohio Elect. & Cont. Co.

Lighting, Industrial
American Fixture Co.
Benjamin Electric Co.
General Electric Co.
Miller Co.
National Screw & Mfg. Co.
Westinghouse Electric & Mfg. Co.

Lightning Arresters
General Electric Co.
Westinghouse Electric & Mfg. Co.

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Ohio Brass Co.

Liquid Storage & Distributing Systems
Bowser & Co., S. F.

Locking Electric Lamp Bulbs
Harvey Hubbell, Inc.

Locomotive Equip't, Elec.
Ohio Brass Co.

Lubricants
Standard Oil Co. (Ind.)

Lubricators, Force Feed
Bowser & Co., S. F.

Machinery, Mixing & Kneading
New England Tank & Tower Co.

Machines
Strand & Co., N. A.

Magnetic Separators
Electric Controller & Mfg. Co.
Ohio Electric & Controller Co.

Magnets, Lift
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
Ohio Elect. & Cont. Co.

Material Handing Equipment
Bassick Co.
Dodge Mfg. Corp.
Link-Belt Co.
Palmer-Bee Co.
Powell Pressed Steel Co.
Shepard Elec. Crane & Hoist Co.
Webster Mfg. Co.

Measuring Instruments, Precision
Norma Hoffmann Co.

Megohm Insulation Meters
Martindale Electric Co.

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An OKONITE Product

OKOCORD

FLEXIBLE PORTABLE CORD & CABLE

Okonite Products

OKONITE INSULATED WIRES AND CABLES

VARNISHED CAMBRIC CABLES

OKONITE INSULATING TAPE

MANSON & DUNDEE FRICTION TAPES

OKONITE CEMENT

OKOCORD

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IMPREGNATED PAPER CABLES

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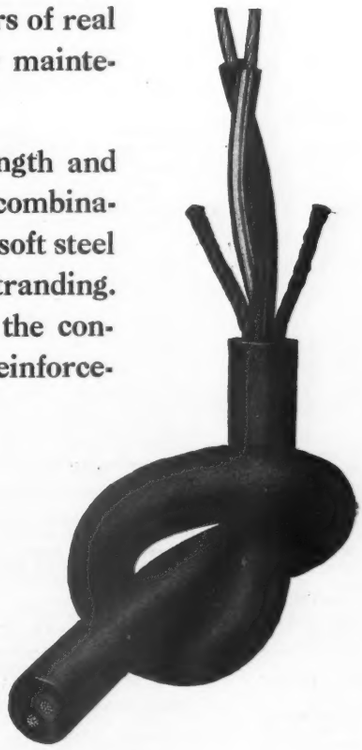
SPLICING MATERIALS

The best hard service flexible cord for rough usage!

A cord that will last, a cord that will resist moisture, oils, greases, acid and alkali fumes, a cord that will withstand the roughest usage, a cord that will give years of real service, a cord that means lower maintenance costs—that's OKOCORD.

Great flexibility, high tensile strength and full conductivity are insured by a combination of annealed tinned copper and soft steel wires assembled in a regular stranding. Seine twine threads twisted with the conductors form a highly efficient reinforcement. OKONITE insulation is used throughout.



Learn how Okocord cords and cables can lower maintenance costs for you. Write us for complete data.

THE OKONITE COMPANY.
THE OKONITE-CALLENDER CABLE COMPANY, INC.

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Novelty Electric Co., Philadelphia, Pa. F. D. Lawrence Electric Co., Cincinnati, O.

Canadian Representatives: Engineering Materials Limited, Montreal

Cuban Representatives: Victor G. Mendoza Co., Havana

Megohmers—for insulation resistance measurements
Herman H. Sticht & Co.

Metal
Molding
Appleton Electric Co.
Monel
Breese Bros. Co.
Terne
Magnolia Metal Co.
Type
Magnolia Metal Co.

Metal Cleaners
Oakite Products, Inc.

Metal Washing
Oakite Products, Inc.

Metal Stampings
American Pulley Co.
Dodge Mfg. Corp.
The Kirk & Blum Mfg. Co.

Meters
General Electric Co.
Roller-Smith Co.
Westinghouse Electric & Mfg. Co.

Meter Testers
General Electric Co.
Westinghouse Electric & Mfg. Co.

Mica
Raw and Products
Mica Insulator Co.

Mica Under Cutting Machines
Hullhorst Micro Tool Co.

Mining Materials, Electric
Ohio Brass Co.

Motors
Allis-Chalmers Mfg. Co.
Baldor Electric Co.
Burke Electric Co.
Century Electric Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Electro Dynamic Co.
General Electric Co.
Howell Electric Motors Co.
Imperial Electric Co.
Kimble Electric Co.
Lincoln Electric Co.
Marble-Card Electric Co.
Master Electric Co.
National Screw & Mfg. Co.
Ohio Elect. & Cont. Co.
Reliance Electric & Eng. Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Westinghouse Electric & Mfg. Co.
Adjustable Speed
Kimble Electric Co.
Electric
Lincoln Electric Co.
Ohio Elec. & Controller Co.
Fractional H. P.
Ohio Elect. & Cont. Co.
Variable Speed
Kimble Electric Co.

Motors, New & Reconditioned
Trester Service Electric Co.

Motor Generators
Allis-Chalmers Mfg. Co.
Burke Electric Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Ohio Elect. & Cont. Co.
Reliance Electric & Eng. Co.
Triumph Electric Co.
Westinghouse Electric & Mfg. Co.

Motor Repairs
Cleveland Armature Works

Motor Supports, Standard
Midwest Steel & Supply Co.

Moulding Machines
Osborn Mfg. Co.

Nut Setters
Strand & Co., N. A.

Ohmers—for low resistance measurements
Herman H. Sticht & Co.

Oil Cup
Gits Bros. Mfg. Co.

Oil Filters
Batch & Continuous
Bowser & Co., S. F.
Transformer & Switch
Bowser & Co., S. F.

Oil Gages
Gits Bros. Mfg. Co.

Oil Engines
Falk Corp.

Oil Purifiers, Centrifugal
De Laval Separator Co.
De Laval Steam Turbine Co.

Oil Storage & Distributing Systems
Bowser & Co., S. F.

Ovens, Electric
General Electric Co.
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0140

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Write for a sample of the cord and further information.

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Immersed in AIR

for SAFETY AND RELIABILITY

A PROMINENT CHICAGO INSTALLATION

A 5000 ampere I-T-E type L G Circuit Breaker for 600 volts or less alternating current service. This breaker is equipped with Overload, Dalite (direct acting inverse time limit), and Autoite (non-closable on overload) features.

I-T-E AIR BREAK has definite advantages not present in the oil breaker

1. No oil—to leak, carbonize, burn or explode—Just air.
2. No tanks to conceal anything—or the lack of it.
3. No cells—nothing which needs or deserves to be imprisoned—Just a faithful and efficient servant.
4. Inherent simplicity—with resulting low cost of installation and maintenance.

THE CUTTER COMPANY—*EST.* 1888—505 N. 19th STREET—PHILADELPHIA

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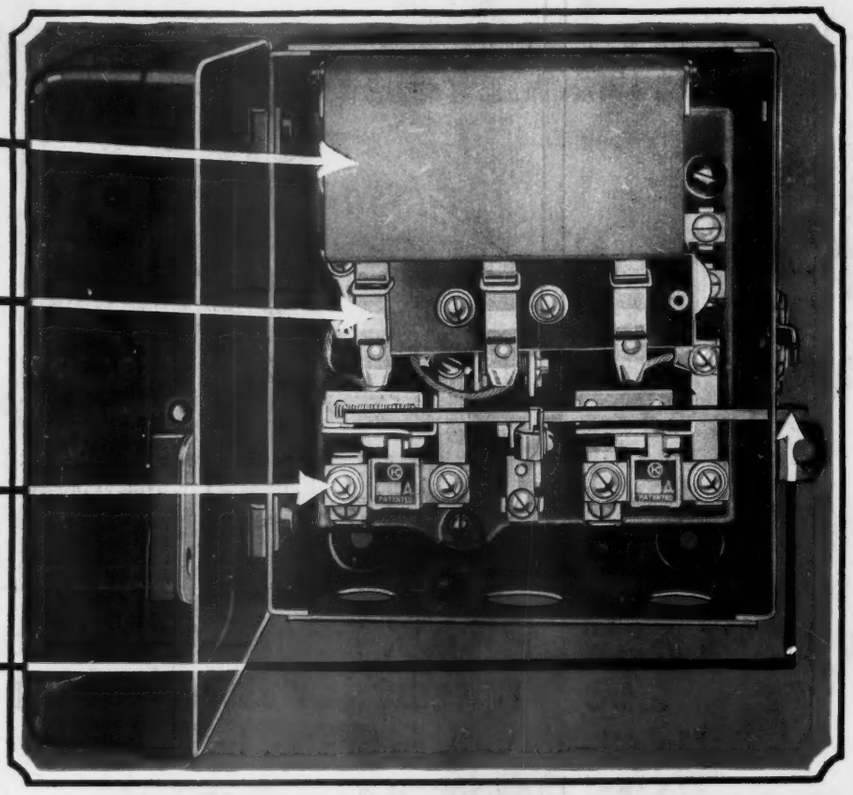
U-RE-LITE · · · I-T-E CIRCUIT BREAKERS

CLASS 8532 Automatic Motor Control

FOR MOTORS UP TO 5 H.P.


Arc Shield Efficiently Confines the Arc
Liberal Contact Tips insure positive contact
I-C Thermal units provide overload protection
Reset Thermal unit from outside of cabinet

A special feature of the Class 8532 A. C. Automatic Starter is its compact design and neat appearance. The cabinet is shallow and projects a minimum distance from its mounting support — a saving of valuable space. The enclosing cabinet is die formed from sheet steel and carefully welded so as to be dustproof. It has a baked enamel finish.

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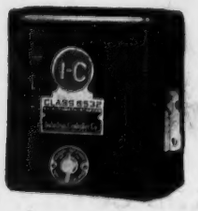

Class 8532 - Type C

A C AUTOMATIC STARTERS

Industrial Controller Co.

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